OCT 8 1928

Compressed Air Magazine

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OCTOBER, 1928

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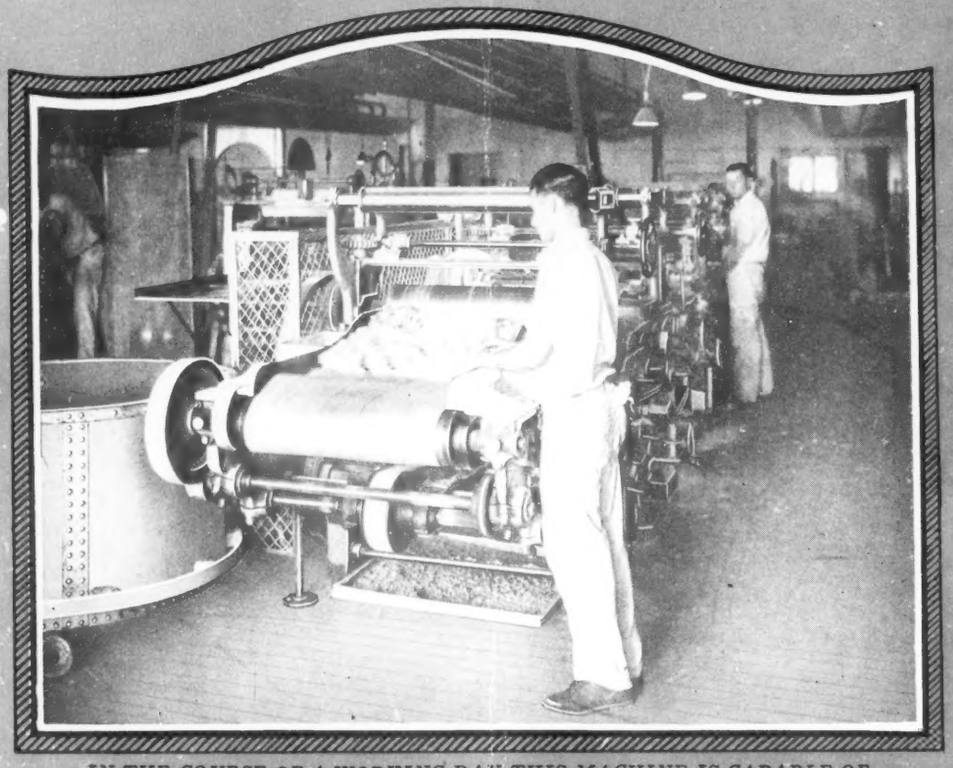

IN THE COURSE OF A WORKING DAY THIS MACHINE IS CAPABLE OF FORMING, READY FOR BAKING, AS MANY AS 830,000 BISCUITS.

Crushed-Stone Plant Proves Economy Possible
A. S. Taylor

Making Biscuits and Crackers for the Multitude
J. S. Meehan

Indiana's Great Limestone Industry
R. G. Skerrett

Use of Compressed Air Increasing in Metal Mining
M. H. Wright

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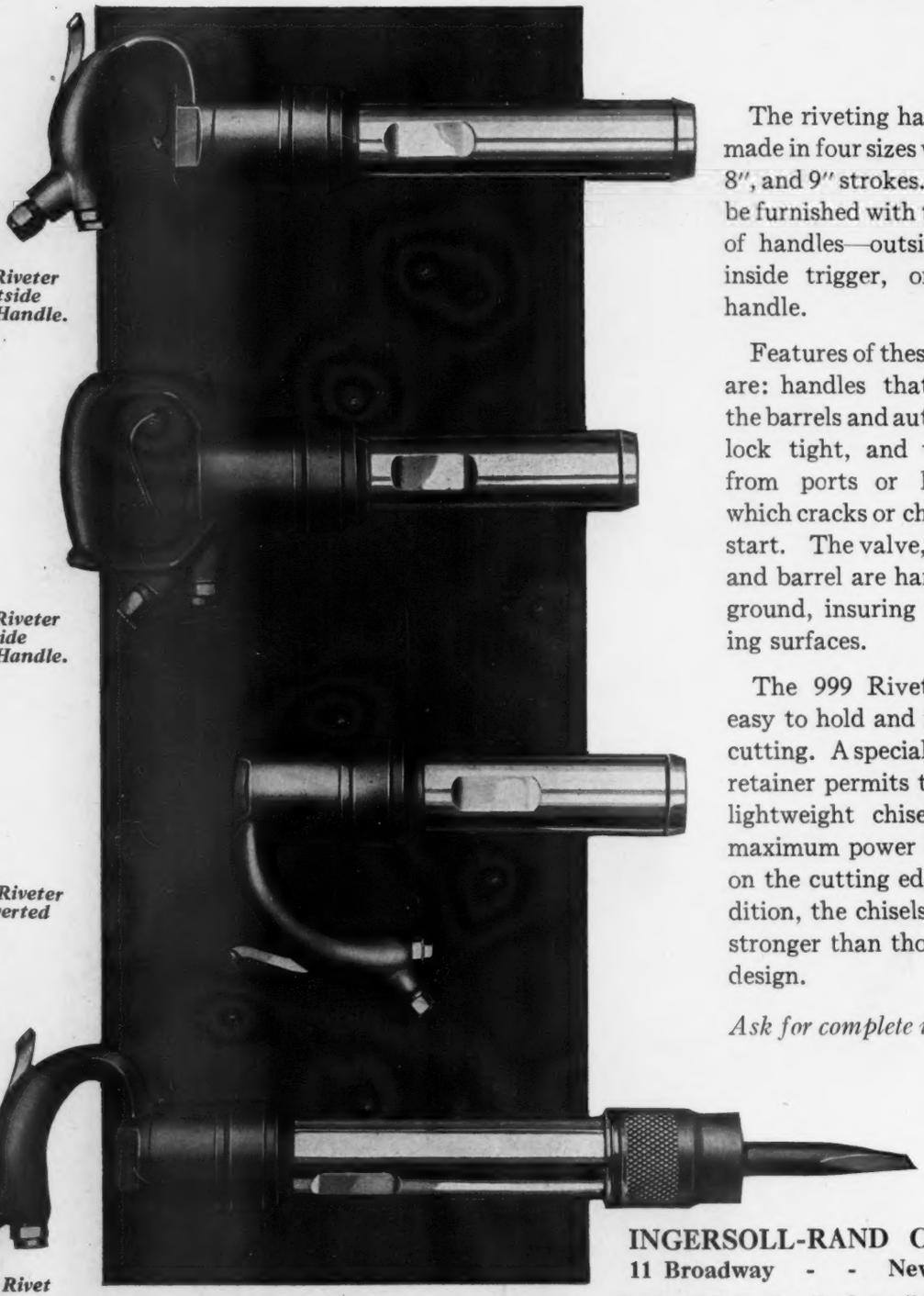
New Riveters and Rivet Buster

that hold better, drive better, and have a more rugged design



Size 8A Riveter with Outside Trigger Handle.

Size 6A Riveter with Inside Trigger Handle.

Size 5A Riveter with Inverted Handle.

Size 999 Rivet Buster.

The riveting hammers are made in four sizes with 5″, 6″, 8″, and 9″ strokes. They can be furnished with three types of handles—outside trigger, inside trigger, or inverted handle.

Features of these hammers are: handles that screw on the barrels and automatically lock tight, and valves free from ports or holes from which cracks or checks might start. The valve, valve-box, and barrel are hardened and ground, insuring long wearing surfaces.

The 999 Rivet Buster is easy to hold and is very fast cutting. A specially designed retainer permits the use of a lightweight chisel, so that maximum power is obtained on the cutting edge. In addition, the chisels are much stronger than those of older design.

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419-PT

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YEARS of service have proved the value of the Carbic Acetylene Generator for welding and cutting. You'll find enthusiastic users in every branch of industry. Thousands of these truly portable generators are in operation all over the country.

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Because it is portable. The popular No. 2 light weighs only 115 pounds fully charged.

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Because it is economical. Costs only a few cents an hour to operate.

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Your jobber can supply you.

CARBIC LIGHT

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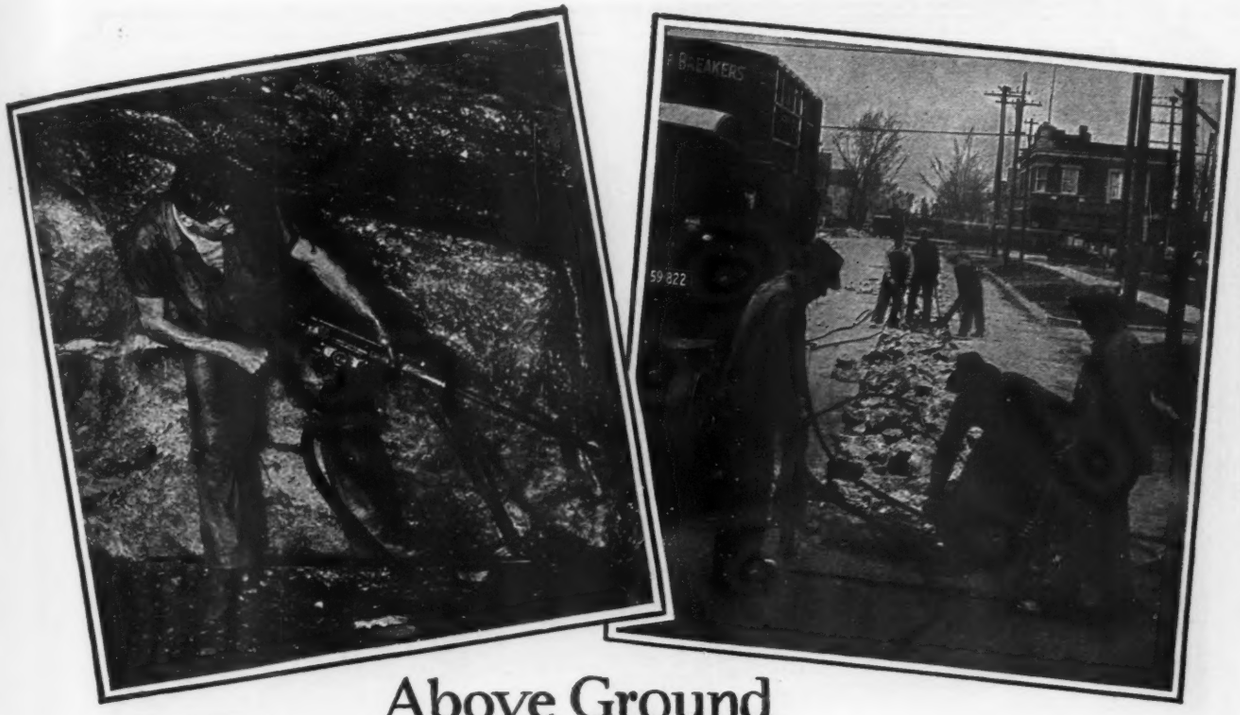

Above Ground or Below Goodrich Hose Gives You "AIR-MILEAGE!"

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The de luxe air drill hose. Oil-proof tube; extra-heavy braided cord reinforcement; double thickness, self-armoring cover.

"TYPE 50"
Tough and strong, yet light and easily handled. For pneumatic tools and light air drill service. Oil-resisting tubes; multiple braided reinforcement.

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A wrapped construction air hose built of the same high-quality materials as "Commander."

Whether on a street paving job in Illinois or in a South African gold mine, the quality of your air hose has a distinct effect on the speed and cost of the work.

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The cover is tough, brawny rubber, 50% stronger than ordinary air hose cover. It will outwear any kind of steel armoring and endure all sorts of abuse—pinching under heavy weights; cutting against sharp corners; chafing against rock or metal.

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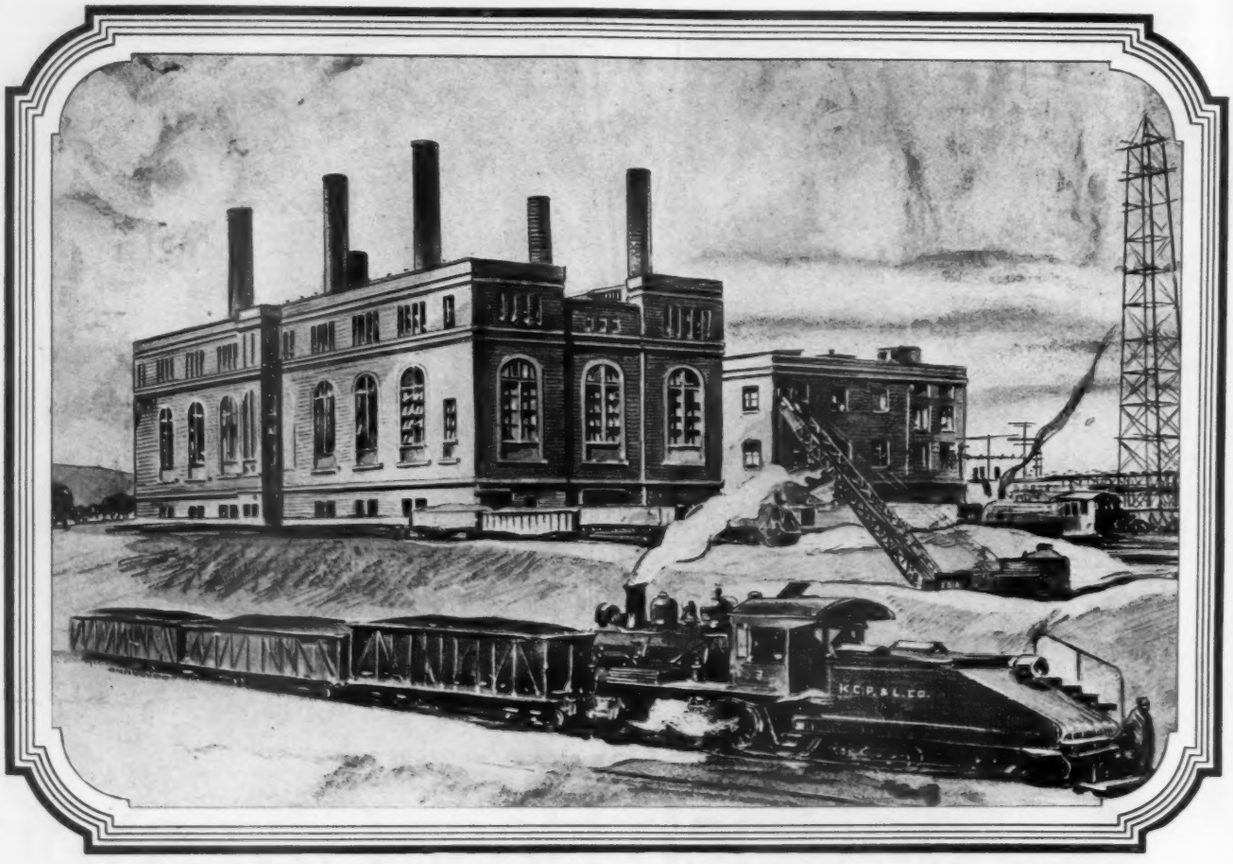
Goodrich AIR HOSE

"Type 50" "COMMANDER" "Type 88"



Northeast Station of the Kansas City Power & Light Co., Kansas City, Mo.

another—

Central Station with Cameron Equipment

The Kansas City Power & Light Company, operating under a total present capacity of approximately 200,000 kw., supplies energy for Kansas City industries, domestic service, city lighting, and street railways.

Its system also extends over a district adjacent to Kansas City and furnishes power and light to 102 communities in 21 counties in Missouri and Kansas, serving a population of about 500,000.

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A. S. Cameron Steam Pump Works

For Canada Refer—Canadian Ingersoll-Rand Co., Ltd., 10 Phillips Square, Montreal, Quebec.

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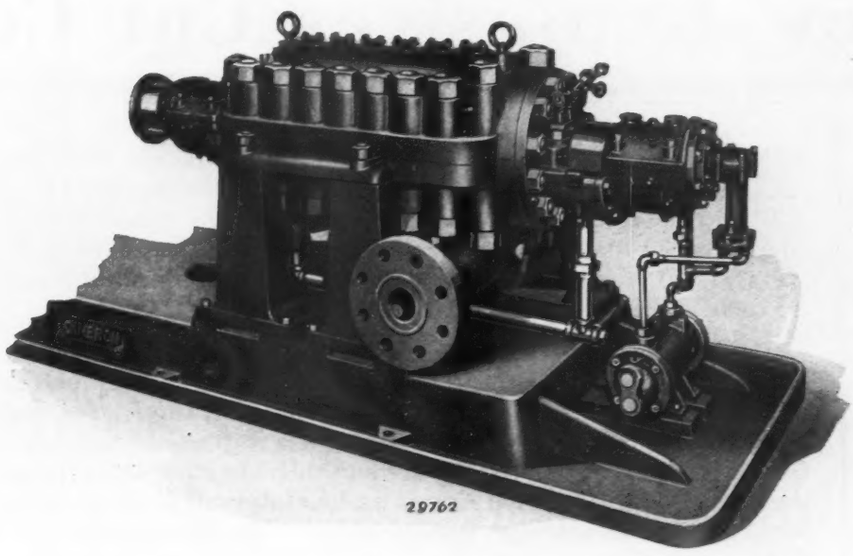

"Cameron"—

the pump for the modern high-pressure power plant

The pump shown above is the No. 4 Cameron "HT"—a six-stage boiler feed pump with a rated capacity of 800 g.p.m. against 1500 lbs. pressure—which was recently purchased by the Kansas City Power and Light Company for their Northeast Station.

The lubricating and balancing features of the unit are outstanding. Correctness of design is attested by the freedom from thrust and vibration, which characterizes its operation.

The Cameron boiler feed pump has the qualities sought by those who demand a pump above the ordinary.

We have just completed the fourth section of our book "The Modern Central Station." It describes some of the most recent developments in a number of outstanding stations. If you have not yet had your copy we will be glad to send it with our compliments.

331-DV

Cameron Pumps

Blasting Practice Is Changing New Explosives Cut Costs

TODAY the man who is familiar *only* with the old standard Extra Dynamites and Gelatins, running 190 to 220 (1¼" x 8") cartridges to the 100 pounds, is behind the times. His explosives costs may be considerably higher than those of his more progressive competitor who has switched to the Hercomites, at a much lower cost per cartridge.

The Hercomites represent one of the greatest explosives values ever offered. They are the safest type of commercial explosives manufactured. Fumes are better than those of the Extras and compare favorably with the Gelatins. They reduce blasting costs from 10% to 30% where they are suitable. On many operations they successfully replace Extras and Gelatins of from 20% to 50% strength, cartridge for cartridge. The Hercomites run from approximately 240 (1¼" x 8") cartridges for Hercomite 2 to 350 for Hercomite 7. The table shows the grade of Hercomite to replace the older types of explosives in various strengths.

HERCOMITE 2 is nearest grade to	60% Extra L. F. or 40% to 50% Gelatins
HERCOMITE 3 is nearest grade to	50% Extra L. F. or 30% to 35% Gelatins
HERCOMITE 4 is nearest grade to	40% Extra L. F. or 25% to 30% Gelatins
HERCOMITE 5 is nearest grade to	30% Extra L. F.
HERCOMITE 6 is nearest grade to	25% Extra L. F.
HERCOMITE 7 is nearest grade to	20% Extra L. F.

Write for descriptive booklet.

For information on other explosives and blasting supplies, see pages 170 to 172 of the 1928 Keystone Metal Quarry Catalog.

HERCULES POWDER COMPANY

(INCORPORATED)

Sales Offices: Allentown, Pa., Birmingham, Buffalo, Chattanooga, Chicago, Denver, Duluth, Hazleton, Pa., Huntington, W. Va., Joplin, Mo., Los Angeles, Louisville, New York City, Norristown, Pa., Pittsburg, Kan., Pittsburgh, Pottsville, Pa., St. Louis, Salt Lake City, San Francisco, Wilkes-Barre, Wilmington, Del.

Hercules Powder Company, Inc.
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Please send me additional information regarding the new Hercomites, No. 2 to No. 7.

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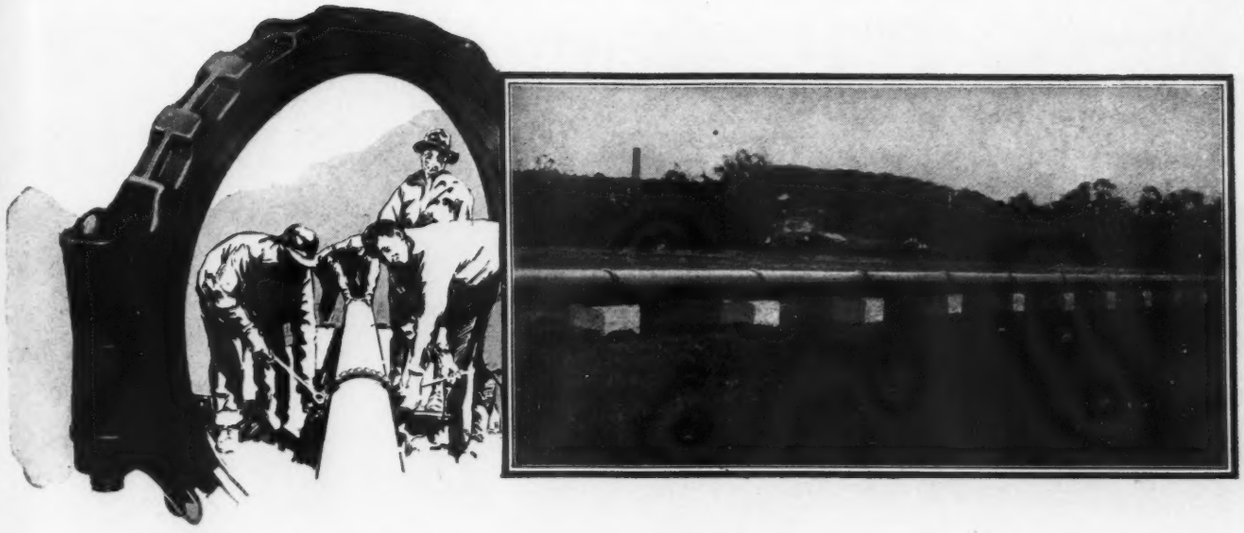

Victaulic Couplings

"For every joint on the line"

THE municipal engineer in charge of laying this 15-inch sewer main across a valley and under a river, writes:

"The whole of the sewer was laid by unskilled labor; by men who had had no previous experience in the use of Victaulic Couplings, and even with this drawback, the time taken for installing the couplings was exceedingly small—not more than five minutes per joint. These facts are exceedingly important because with ordinary caulked joints, skilled men must be employed and the time taken would be at least twenty times more. A portion of the line was laid under the river.

"Victaulic Couplings are extremely suitable where iron pipes are to be laid in water, as a perfectly water-tight joint can be made in a few minutes, which is impossible, or to say the least, difficult, with caulked joints even when lead wool is used."

* * * *

Besides speed, ease and economy in laying, Victaulic Couplings provide a high degree of flexibility in the line which can be shifted under pressure or can sag without impairing in the least the leak-proof quality of the Victaulic Couplings.

The line is strain-free because Victaulic Couplings act as expansion joints for the lengths of pipe they connect. It will not buckle or pull apart when temperature changes cause the pipe to contract or expand.

Victaulic Couplings are supplied for steel, wrought-iron, and cast-iron pipe—in all sizes from ¾ inch up—for all pressures from vacuum to 10 tons pressure per square inch. Victaulic Fittings make it easy to connect up with any existing type of line.

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EASTERN SERVICE COMPANY
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All-Purpose Coupling.

"For every joint on the line"

FLEXIBLE LEAK-PROOF

VICTAULIC

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PIPE COUPLINGS

For detailed information and list of uses and users, fill in and mail the coupon.

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FOR CRUDE OIL · GAS · WATER · SEWAGE · COMPRESSED AIR, ETC.

"Do not believe any other can even compete with it"—

Electric shovel gives *Lower Cost per ton*

More and more quarries are now standardizing on the electric shovel—wherever electric power is available at a reasonable cost.

The same economies that quarrymen have noted when driving their crushers and other stationary equipment by electricity, are now being obtained in loading rock at the quarry face by electrical power.

Many owners of 3-yard and 4-yard BUCYRUS-ERIE electric shovels report a loading cost of 1¾c per ton, or less—this figure being the average for a month's operation, including all costs for shovel crew, insurance, power, etc. *And the smaller electric machines are doing nearly as well.*

— writes E. E. Cooke, Superintendent of the Carolina Stone Company, Pageland, S. C., after using their 50-B BUCYRUS-ERIE for two years in the hardest of granite quarry service. He goes on to say:

"Two years in a granite quarry is a rigid test for any machine, and we have found the 50-B BUCYRUS-ERIE electric shovel very Reliable and Economical."

Month after month this Reliable machine loads out the rock, giving steady big outputs. Mr. Cooke reports that this 50-B BUCYRUS-ERIE electric loads an average of 1000 tons of rock per shift, and has given as high as 1,200 tons per shift.

When you talk to quarry operators who know, you soon see why they can depend on BUCYRUS-ERIES for such remarkably steady production. Experienced owners like Mr. Cooke have found that their BUCYRUS-ERIES are built stronger, to stand the faster pace that they set in the toughest digging. Built with the right steels in the right places—simpler and more rugged.

Write us about your digging and rehandling work, and we'll send you some performance records that BUCYRUS-ERIES have made in work like it.

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General Sales Offices: South Milwaukee, Wis., and Erie, Pa.

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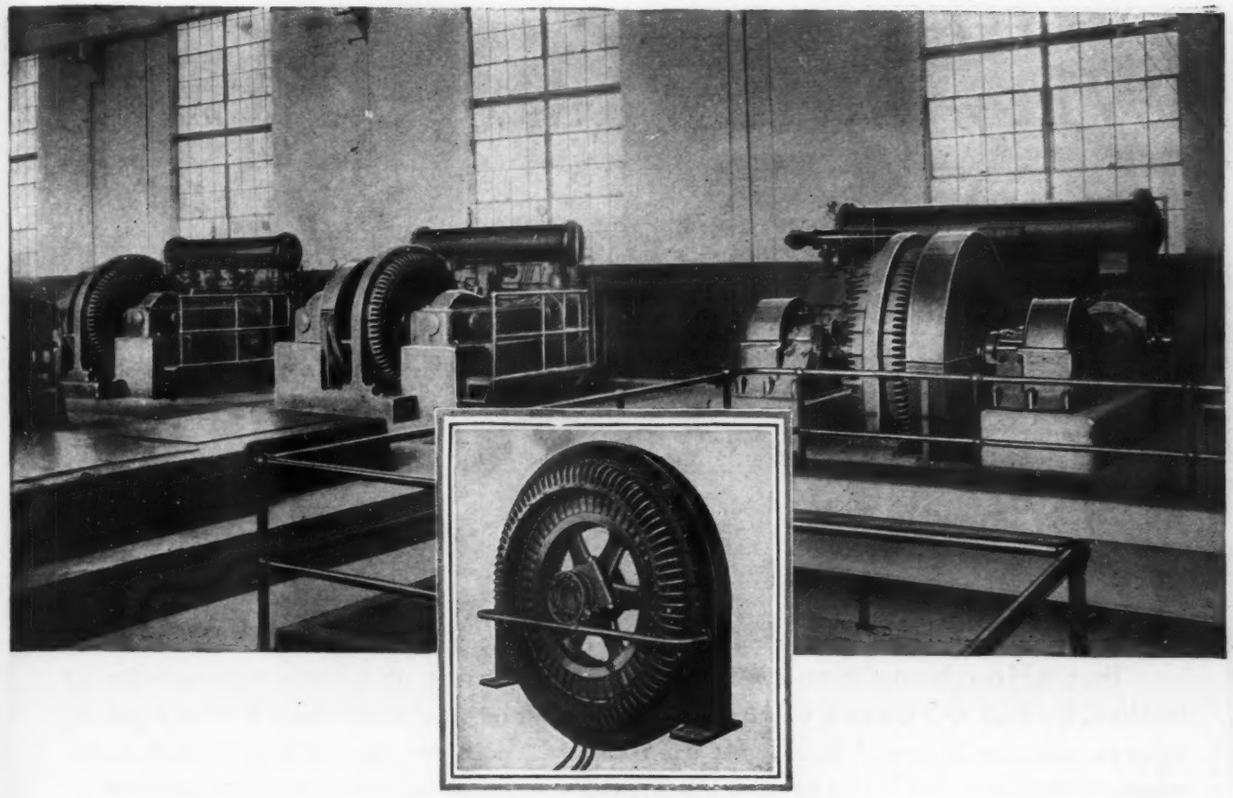
Offices and agencies in all the principal countries throughout the world.



Investigate the economies of G-E synchronous-motor drive for compressors

These motors are highly efficient, simple in construction, low in maintenance. When direct-connected to compressors, they form as compact, as reliable, and as economical a drive as you can have.

Compressors, operating continuously, make power-factor improvement possible *all the time*, when synchronous-motor drive is employed.

Learn about the advantages of direct connection of G-E motors to compressors. The nearest G-E office is always ready to supply complete information.

G-E Motorized Power is individually fitted to each compressor by close coöperation of G-E engineers with the compressor builder. A unit is thereby formed which gives you complete assurance of satisfactory operation.

Motorized Power
–fitted to every need

107-28

GENERAL ELECTRIC

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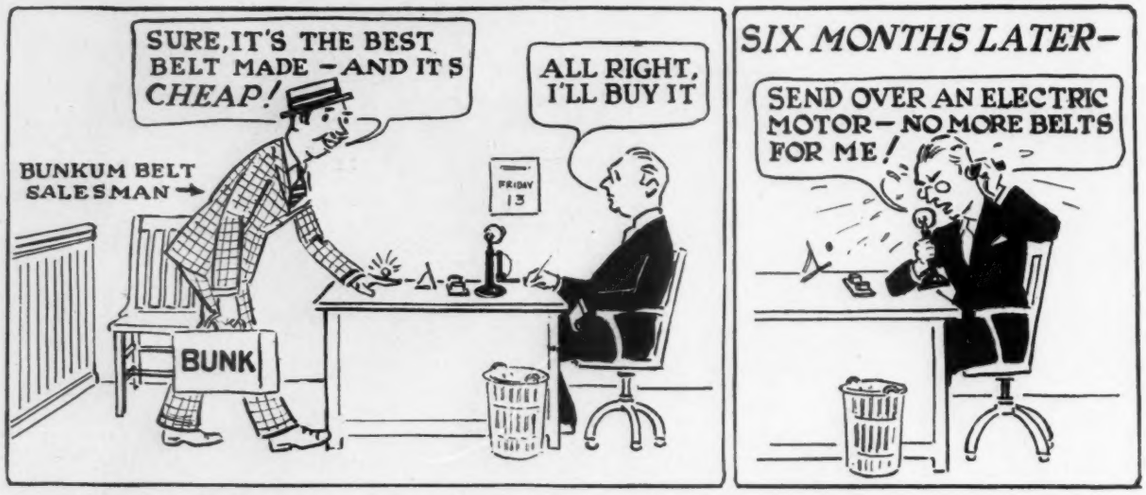
Why belts leave home


SURE, IT'S THE BEST BELT MADE – AND IT'S CHEAP!
ALL RIGHT, I'LL BUY IT
BUNKUM BELT SALESMAN
BUNK
FRIDAY 13
SIX MONTHS LATER–
SEND OVER AN ELECTRIC MOTOR – NO MORE BELTS FOR ME!

But a Houghton Man called just in the nick of time - a man who is backed by the 63 years of Houghton experience and who knows power transmission from A to Z. He explained the economies of group drive-electric motors and VIM leather belting - an unbeatable combination.

– So the picture now becomes

Why VIM belts win

VIM is MADE FROM THE BEST HIDES OBTAINABLE AND THEREFORE CAN'T BE CHEAP. VIM IS ABSOLUTELY THE BEST BELT YOU CAN BUY. VIM BELTS, PLUS ELECTRIC MOTORS,-ETC.
SOUNDS PRETTY EXPENSIVE, BUT I'LL TRY IT OUT.
TEN YEARS LATER
COME OVER AND SELL ME SOME MORE VIM BELTING. THE WHOLE PLANT IS GROUP DRIVE NOW, AND ALL BELTS ARE VIM

VIM is the strongest, toughest, lightest, *most flexible*, high friction belt in the world. It pulls over 20 per cent more than the best oak and lasts more than *twice* as long. It is a special Houghton mineral tan. A Houghton Man will gladly tell you all about it.

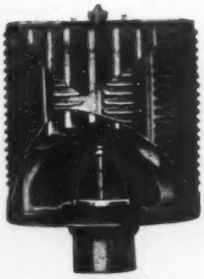
See our exhibit at the National Metal Exposition, Philadelphia, week of October 8th. Booths No. 121 to 126.

E. F. HOUGHTON & COMPANY
P. O. Box 6913, North Philadelphia, Pa.
AND ALL OVER THE WORLD

C27-57

Is it Shortening the Life of Your Compressors?

Unfiltered air contains upwards of 100,000 dust particles per cubic inch—ABOUT A HALF POUND OF SAND AND GRIT FOR EVERY MILLION CUBIC FEET OF AIR YOU COMPRESS! This abrasive matter grinds and scores smooth reciprocating parts—cuts down operating efficiency—and it shortens the life of pneumatic equipment.



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Install Protectomotor Air Filters and your compressors, engines, blowers and compressed-air tools will operate with air that is guaranteed to be 99-9/10% CLEAN.

PROTECTOMOTOR AIR FILTERS

REG. U.S. PAT. OFF. 99 9/10 Per Cent EFFICIENT

Reduces carbon deposits by as much as 70%. It reduces normal wear by as much as 85%. And it enables you to operate three to five times longer without overhauling.

This remarkable device has no valves or moving parts. Nothing to get out of order. No tanks, cleaning solution or spare parts required. Needs cleaning only twice a year. Simply install it and forget it. Over 250,000 in use.

Sectional View
Model CP
Pipe Line Filter

Also made for installation in pipe lines. Delivers clean, dry air, free from dust, water, oil, rust and scale, for paint spraying, compressed-air tools, hoists, cleaning operations, agitating liquids, etc.

Illustrated booklet tells complete story. Write for it today and get the facts on increasing the life of your pneumatic equipment. Or simply mail the coupon.

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Please send copy of your Booklet on Protectomotor Air Filters.

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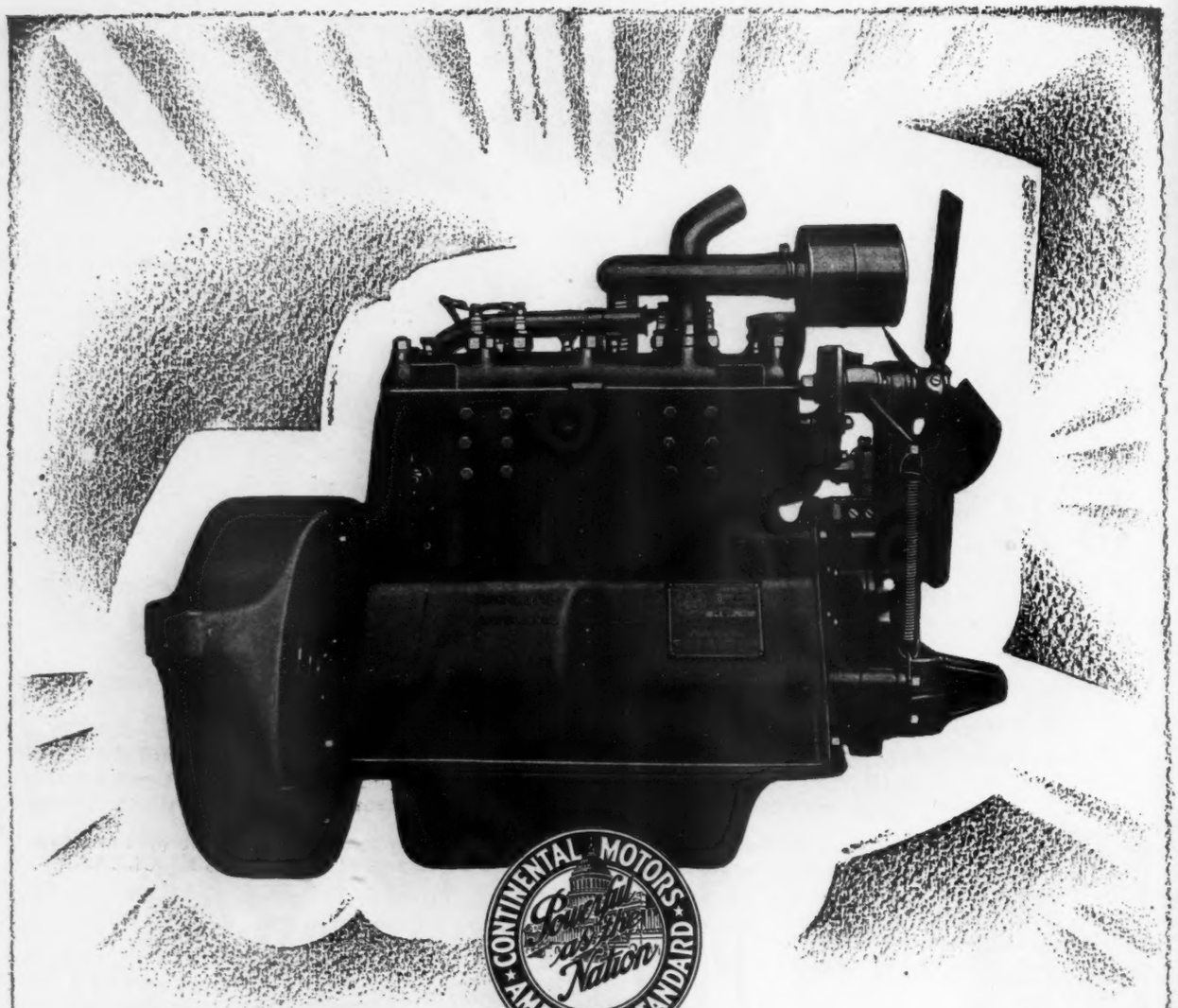

As each succeeding year adds its experience to both the manufacturer and operator of air compressor units, there is built up a greater appreciation of that indispensable quality — dependability.

Gasoline motor-driven compressor units, which have sales value and which are capable of doing a day's work every day at a profit, must have the kind of dependable power which only years of experience and the most modern manufacturing facilities can build into an engine. And the company behind the engine must have a dependability proven over the years.

The famous Red Seal on the crankcase of the engine which drives the air compressor identifies it as built and protected by Continental Motors Corporation, the industry's largest and most dependable producer of dependable gasoline power.

CONTINENTAL MOTORS CORPORATION
INDUSTRIAL EQUIPMENT DIVISION
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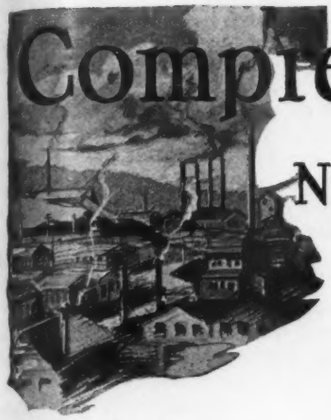
The Largest Exclusive Motor Manufacturer in the World

Continental Motors



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Principal Offices
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No. 11 Broadway
New York.

Vol. XXXIII, No. X

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Compressed Air Magazine Co.
OCTOBER, 1928

Indiana's Great Limestone Industry

The Bedford-Bloomington District Produces Great Volumes of Stone Suitable for Many and Varied Purposes

By R. G. SKERRETT

INDIANA limestone constitutes more than 35 per cent of all rough and finished stone used in building operations in the United States, and more than 65 per cent of all finished building stone used in the country. What is equally worthy of note is that fully one-third of that 65 per cent of all finished cut stone originates in the cutting plants located in the Bedford-Bloomington district of Indiana adjacent to these famous quarries.

The part played by these quarries in the stone industry of America will become clearer if we mention that they yield approximately 14,000,000 cubic feet of block, sawed, and cut stone annually. If transported by a single train, 32,000 cars would be needed to move the stone from the quarries to the market. If the blocks were piled on a base 55 feet square—corresponding to the area of the base of the Washington Monument at the National Capital—they would make a column 4,628 feet high. No wonder that this material, so admirably suited for many and varied architectural purposes, should have won for itself the title "The Nation's Building Stone". It is employed in modest structures in a diversity of ways, as well as in those massive or towering edifices that are appropriately spoken of as architectural masterpieces.

This adaptable limestone comes from a vast deposit that was laid down millions of years ago, in Paleozoic time, in the region now occupied by two counties in the southern part of the state—namely, Lawrence and Monroe. The deposit is known to extend north and south for a distance of 40 miles, and to have a breadth east and west, varying from 2 to 7 miles. The stratum of marketable or commercial stone has an average vertical thickness of about 40 feet. It has been authoritatively computed that there is sufficient of this excellent stone remaining in proven areas to permit the continuance of the present rate of production, with normal increase, for at least 70 years to come.

INDIANA limestone has been quarried ever since 1840, when operations were begun on a small scale and by hand. Today, the more than half a hundred quarries in the Bedford-Bloomington district are producing annually substantially 14,000,000 cubic feet of block, sawed, and cut stone. They are doing this because modern methods and up-to-date machinery are employed both in quarrying and in working this stone.

Indiana limestone is used throughout the length and the breadth of the land owing to the fact that it possesses to an outstanding degree a great many desirable physical and structural characteristics, and can be had at a decidedly moderate price.

The accompanying story summarizes the history of the industry and describes the methods now generally used in getting the stone out of the ground. These methods represent the present climax of many difficulties progressively overcome.

The valleys and the slopes of the picturesque hilly region in which the numerous quarries lie have long formed a fruitful agricultural section of Indiana; and in the summertime far-flung and billowing fields of cereals add colorfulness to the landscape. With such a scene before one, it is hard to visualize the physical conditions that prevailed there in the remote past. According to geologists, the region was once part of the bed of a sea that extended inland from the Gulf of Mexico north to the Valley of the St. Lawrence River.

The clear waters that marked some periods of that inundation were alive with marine creatures whose bony structures or shells were formed of carbonate of lime drawn from that sea. As these creatures died, they settled to the water bed in the form of shell-sand—their carbonaceous structures surviving to become consolidated later under the pressure of the cumulative deposit and the weight of water and of solid matter resting upon them during protracted ages. The skeletons or shells of these minute forms of animal life were, in time, cemented or bound together with similarly pure carbonate of lime precipitated by the superposed sea.

Because of the manner in which the deposit acquired and retained the form of tiny egg-like bodies, intermixed with the fossilized shells of invertebrates, Indiana limestone is technically classed as an oölitic limestone. Therefore, the architectural structures that tower skyward for hundreds of feet are, when built of this limestone, actually Nature's enduring monuments to the amazingly small creatures that once constituted much of the teeming life of the warm waters that then lay above the sunlit and rolling hills of present-day Indiana.

The way in which this oölitic limestone was produced in the geological laboratory of the distant past imparted to the stone properties which make it of distinctive value to the architect and to the stoneworker. That is to say, it possesses charm of color, a pleasing variety of texture, notable ease of cutting, and, last but not least, marked strength and weather-

ing qualities of a high order. In short, Indiana limestone, thanks to Nature's bounty, is generally superior to the limestones that have been used abroad in rearing many of Europe's great and most admired masonry structures—edifices that are still splendid after standing for centuries.

Indiana limestone can be readily quarried in blocks of sizes suitable for a very wide range of requirements. The stone comes from the quarry in a somewhat soft condition that makes it easy to cut into any architectural or structural shape by machine processes, but it is sufficiently tough when it reaches the carver to permit him to cut the most complicated designs or ornamental details without fear of breakage. When placed in the body of a building and seasoned by exposure to the air, the stone becomes increasingly hard and correspondingly resistant to the wearing and weathering actions of wind, rain, frost, and gases, and other atmospheric impurities. Because the stone is homogeneous and free from the cleavage planes characteristic of many other rocks, Indiana limestone can be split, cut, or carved with well-nigh equal facility in any desired direction. No wonder, then, that the stone is a delight to the craftsman who has to shape it or to give it a decorative form or finish.

The limestone industry of southern Indiana had a modest beginning about 1840; and, needless to say, the rock was quarried by hand methods—the working day then being a long one and the cost of labor low. Gradually, the number of persons or concerns engaged in the business increased, and the field of usefulness of the stone broadened. Between 1860 and 1870, this oölitic limestone was employed in buildings of importance in Chicago, Indianapolis, and elsewhere. In the early "eighties", some of the stone was shipped to New York City; and from that time onward, recognition of the merits of Indiana limestone became general in this country.

The history of the industry is much like that of the early days of other quarry undertakings—transportation being crude in the beginning and depending upon horses a oxen for motive power. Even when the I diana operators provided feeder lines to ca their stone to the trunk-railway systems, w the quarry roads were of narrow gage a necessitated the reloading of the rock at t points of intersection. This added to ope ting costs and imposed decided limits up the sizes of the blocks that could be handl It was not until 1877 that the feeder lines w changed to broad gage, so that regular freig cars could be loaded right at the quarries derricks capable of picking up pie of limestone weighing many to The industry as it exists today m be said properly to date from t "nineties", when the employm of mechanical methods of quarry became general.

Top, left—The vertical cuts in the near end of the quarry floor show plainly how the machines channel a bed of Indiana limestone. Oval—"Jackhamers" are sometimes used in stripping a bed of commercial limestone by drilling and blasting. Bottom, left—Stripping the overburden hydraulically. Cameron pumps deliver the water to the nozzles at a pressure of about 250 pounds. Right—This picture gives a good idea of the splendid proportions of some of the Indiana limestone quarries.

The foregoing particulars are mentio so that we may see that the industry in I diana has advanced step by step with t march of engineering progress—adopti new practices and new equipment as th proved advantageous and suited to the co ditions prevailing in the Bedford-Bloomingt district. Keen competition among the m erous quarrymen has made them alert a continually on the watch for improvements apparatus that would make it possible f them to get out more stone in a given ti

1—A group of channelers at work on the first floor of a quarry. Some of the rows so cut have been turned down. 2—Close-up of the pulling of the key block, making the first opening in the key-block row of a new quarry floor. 3—The edge of a bench that has been channeled and bottom cut, showing one section of rock turned down and a second section being pulled over by the derricks. 4—A large cut of stone that has been turned down and is being split into mill blocks. 5—The stacking yards of the Dark Hollow Quarry with blocks of limestone piled high for seasoning.

Left—Some of the 36 monolithic columns of Indiana limestone forming architectural features of the Pennsylvania State Capitol. Each column is 33 feet 5 inches long and 4 feet 10 inches in diameter. Right—Carvers at work upon large Corinthian capitals of Indiana limestone.

or to effect economies in one way or another. This urge has been largely responsible for the widespread knowledge of Indiana limestone, for its extensive use, and for the comparatively low price at which it has so often been sold.

While there are more than half a hundred openings or quarries in the Bedford-Bloomington district, and numerous concerns are engaged in getting out limestone there, this article will have to do with but one of those enterprises—the largest of them, the Indiana Limestone Company, through whose courtesy we were able to gather the needful data and to take many of the photographs reproduced in connection with our story. The Indiana Limestone Company is a consolidation of 24 companies that worked independently prior to June, 1926. Because of its size and the wealth of its experience, the Indiana Limestone Company is a stabilizing influence in the industry; and it typifies in its practices what is deemed best in the way of operating efficiency and economy of production. The methods employed by it in quarrying the stone are those generally followed in the district.

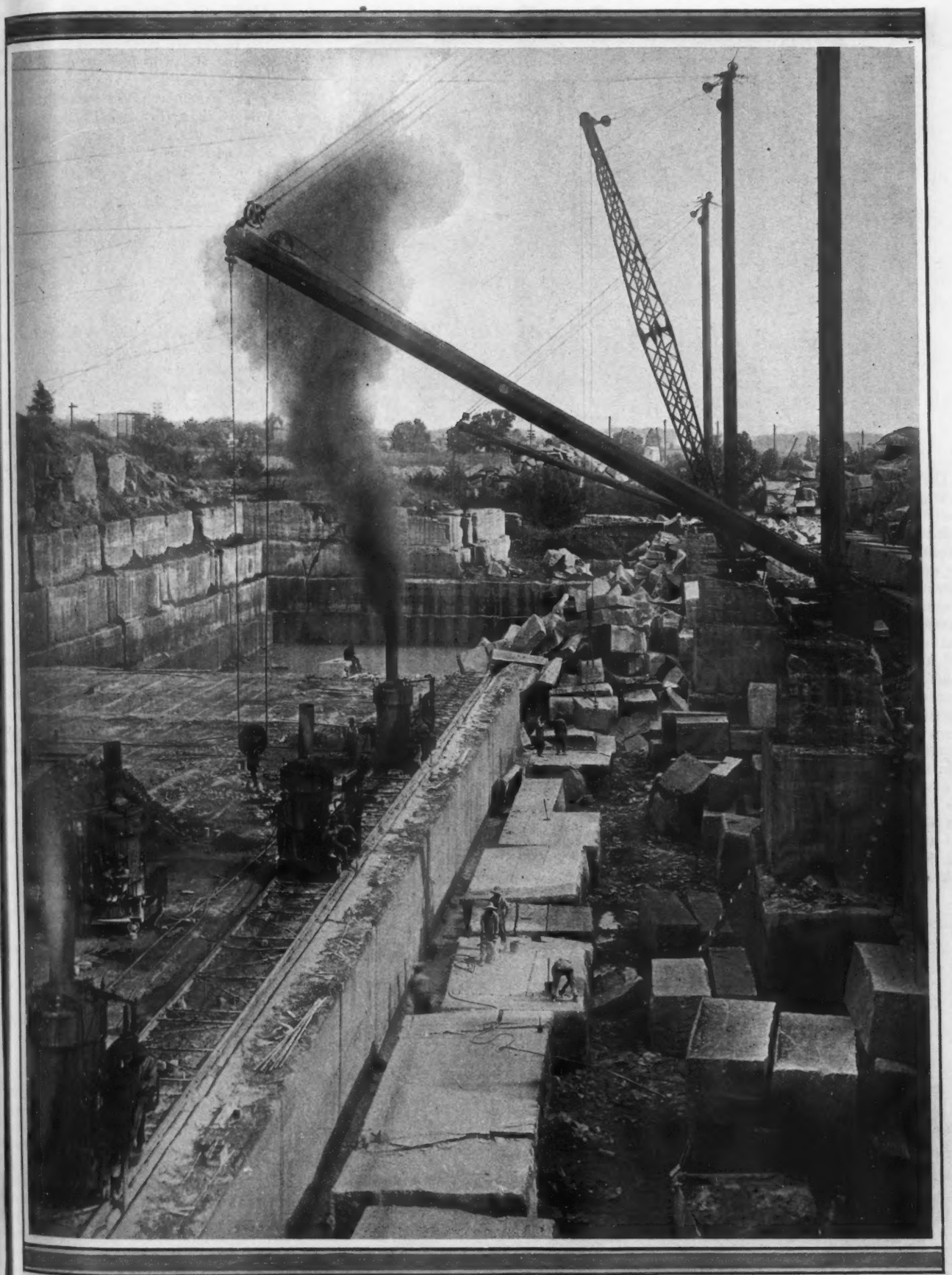
Before describing the manner in which the limestone is quarried, let us sum up briefly its outstanding physical characteristics. It is a noncrystalline rock; and the aggregate, filler, and matrix are all pure carbonate of lime. The average chemical analysis is as follows:

Carbonate of lime	97.23	per cent
Carbonate of magnesia	1.20	" "
Silica	.74	" "
Alumina	.56	" "
Oxide of iron	.15	" "
Water and loss	.12	" "
	100.00	per cent

Other physical data are: average weight (dry) 144 pounds per cubic foot; average absorption by weight 4.6 per cent; and the average crushing strength of the seasoned stone ranges from 6,000 to 8,000 pounds per square inch. For all practical purposes, Indiana limestone is fireproof. It calcines at a temperature above 1,500° F.; and if drenched with cold water when at a temperature of 1,000° F., the stone will not spall, crumble, split, or check. The stone is remarkable because of its internal elasticity, which enables it to adapt itself without damage to extreme temperature changes such as are common in certain sections of this country and of Canada.

In order to reach the stratum of commercial stone, the operator must get rid of the overburden of earth and unmarketable limestone. This overburden varies in depth or thickness from a few inches to 60 feet. The earth may be cleared away with power shovels or by a newer method—that is, by hydraulic stripping. In hydraulic stripping, which has been practiced in the Bedford-Bloomington district during the past eight or ten years, a nozzle pressure of about 250 pounds is employed, and the powerful streams of water scatter the earth and wash it away. With the earth removed, the next step is to get rid of the stratum of unmarketable limestone. This is done by drilling and blasting. Well drills do the drilling when the rocky overburden is 20 or more feet thick. In some cases, however, where conditions are favorable, the stripping is done with "Jackhamers"; and black powder is used to break the undesired rock free because it does not crack the underlying commercial limestone as dynamite might do. No explosives are used in quarrying the commercial rock. Assuming that the overburden has been cleared away, now let us see how they get out the marketable limestone.

Left—Gang saws simultaneously cutting several blocks of Indiana limestone into slabs of different thicknesses. Right—Group of steam channelers at work on two floors of an Indiana limestone quarry.



A large quarry opening, with steam channeling machines at work on the third floor from which Indiana limestone is being taken.

Two of the numerous Ingersoll-Rand compressors that supply air for various purposes to the quarries, cutting sheds, and mills of the Indiana Limestone Company.

The gigantic scale upon which this work is done suggests that Cyclops rather than relatively puny men should be engaged for the task. This is overcome by utilizing power-driven machines, called channelers, which cut deep slots, 2 inches wide, in the exposed floor of the quarry—the depth of the channel ranging from 8 feet to more than 12 feet, depending upon the cross section of the blocks that are to be taken out. Single blocks 16½ feet long and 7¾x8½ feet in cross section, weighing approximately 200,000 pounds, have been quarried. In fact, blocks of Indiana limestone are limited only by the lifting strength of derricks and the capacities of freight cars.

In starting operations on a quarry floor—assuming the floor to be 100 feet wide by 250 feet long, a channel is cut from side to side and to a depth, let us say, of 10 feet. A second and paralleling cut is then made in the ledge at a distance of 8 or 10 feet. The intervening rock constitutes what is called the "key-block row" The channeling machines are next turned at right angles so that they can slice, like a loaf of bread, the key-block row at intervals of 2 feet. The first of these slices to be removed is known as the "key block". The key block is broken free at the bottom of the four enveloping cuts or channels by driving a series of big or bull wedges in one of the cross cuts. The onesided thrust or action of these wedges, when hammered home, generally serves to break the block free on a horizontal plane at the bottom of the channels. After that it is necessary only to drill with "Jackhamers" opposing holes at two ends of the block so that the hooks of chain slings can be secured to the block. With this done, the derrick lifts the block clear of its age-old place in the ledge. With the removal of the second block. in the same manner, the key-block cavity becomes large enough for a drill runner, using a "Jackhamer", to drill a succession of shallow horizontal holes at the bottom of the third block and to break it loose by driving wedges and "feathers" in the line of ho This procedure is continued until several the blocks are removed so as to provide opening about 10 feet square in the qu floor.

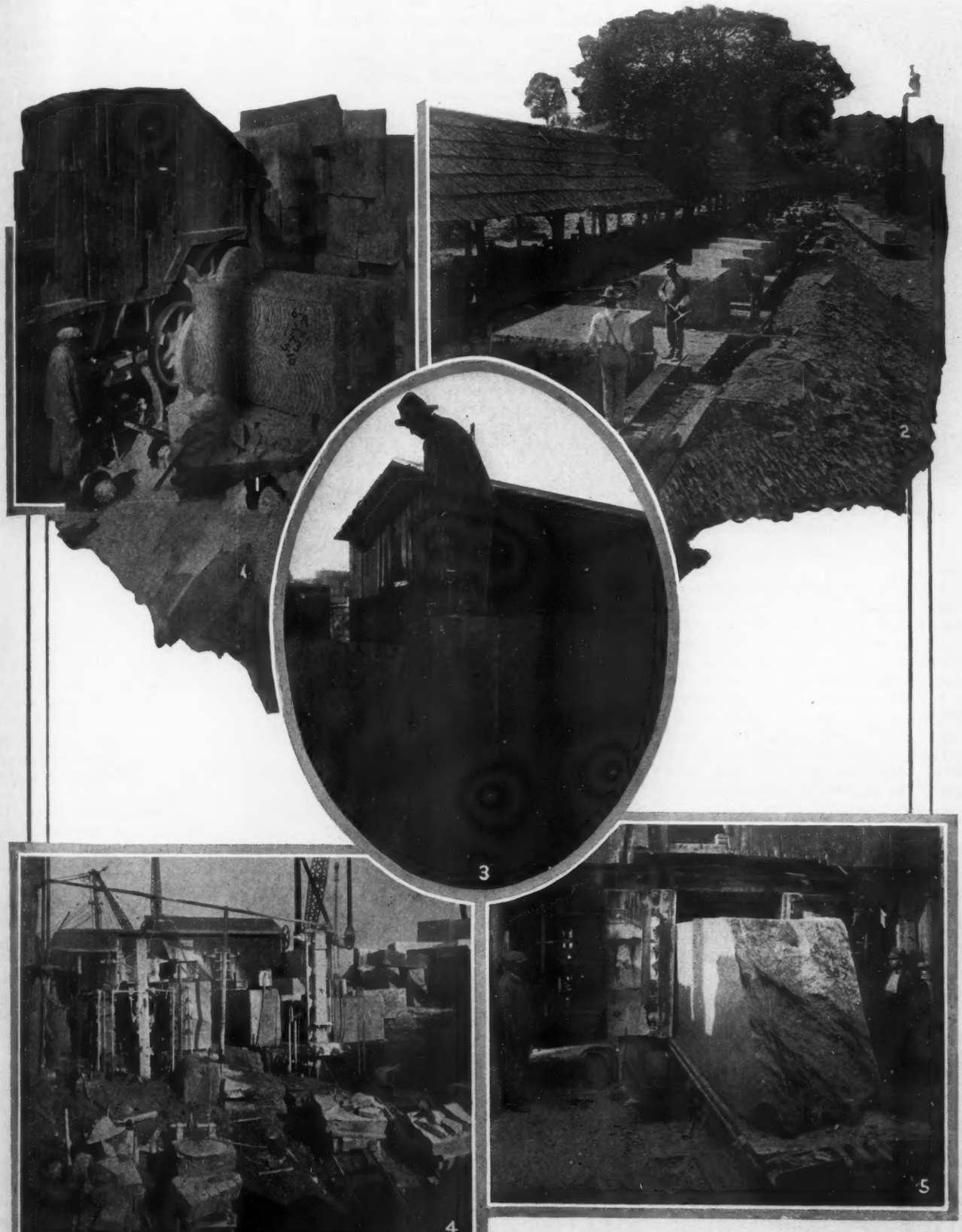
The remainder of the rock in the key-bl row is channeled crosswise at intervals from 3 feet 8 inches to 4 feet 2 inches, ag ably to the size of the dimension stone sired, and split free with wedges and s feathers driven into the holes that have b drilled horizontally about 8 inches apart the base of each block. The blocks are t bled over or "turned down", as it is ter into the openings as they are detached f the ledge. These cuts of stone are promp picked up by derricks, as previously descri in the case of the key block.

After the key-block row has been clea then it is practicable to turn down a si cut of stone quite as long as the quarry f is wide—holes having first been drilled w "Jackhamers" along the entire base of row and the rock split free with wedges feathers. When the width of the quarr such as to make this procedure too cumb some, it is customary to split the cut into or more sections by cross channeling. T several operations described are made m understandable by the accompanying il trations.

When the great blocks have been pulled by the hoisting engines of the derricks turned down on the quarry floor, then t are split into smaller blocks of average c mercial sizes, called "mill blocks"—shal holes drilled with "Jackhamers", and wed and feathers being used to accomplish t Unless there is some reason to shift the fre quarried limestone to distant points, i usual to pile the blocks in a near-by stack yard where they can undergo a seasoni period of a few weeks. The blocks are stac so that the air will circulate freely among th and induce the evaporation of the "sap" moisture content of the stone. A hole dri in a newly quarried block will sometimes s an accumulation of water in the course o single night. This moisture content has advantages, because it undoubtedly make easier to machine and to square the blo immediately after their removal from quarry. As the moisture evaporates the s becomes increasingly harder. Some of pictures show scabbling machines and w saws engaged in cutting and squaring rece quarried blocks of limestone. The quarry season extends from May to November, clusive.

Mill blocks range from 8 to 12 feet in leng and are either 3 feet 6 inches by 4 feet o feet square in section. These blocks cont approximately from 120 to 200 cubic feet stone, and can easily and economically shipped or handled and worked at stone c ting plants. Blocks of greater proportio can, of course, be quarried and transpor whenever needed for special purposes, su as for large monolithic columns or for statu groups. It may be of interest to mention th on numerous occasions monolithic colum 5 feet in diameter and 34 feet in length h

The fine building in Bedford, Ind., that houses the executive offices of the Indiana Limestone Company.



1—Rotating disks squaring blocks of limestone preparatory to shipment. 2—Scabblers formerly used to shape by hand the blocks of limestone after they came from the quarries. 3—Drilling plug holes with a "Jackhamer" in order to split to desired dimensions with plugs and feathers. 4—The wire saw has proved an effective means of cutting and squaring large blocks of Indiana limestone. 5—Here we see a rough block of Indiana limestone being surfaced simultaneously on two sides by being run back and forth between the steel blades of a planer.

A. E. Dickinson.

been produced and carried to points hundreds of miles away.

Spectacular and impressive as the pit operations are—amazing one by the huge masses involved and by the magnitude of the quarries, still wonderment does not cease there: the cutting sheds are revelations of what can be done with the limestone after it is delivered to the various machines or to the men whose skillful chisels form it and adorn it for special purposes. Much as we should like to dwell upon this department of the industry, we are forced to refrain because of the space here available. We shall let our photographs tell this part of the story.

In addition to those essentially physical properties of Indiana limestone that commend it to the architect, there are two other factors that contribute to the favor that the material has won for itself—namely, the ease with which stone of a given sort can be had in abundance, and the varieties of coloring and texture that are obtainable. For the sake of convenience, the Indiana Limestone Company has thus classified its products according to color and texture: select gray, standard gray, and coarse gray; select buff, standard buff, and coarse buff; and variegated. Certain of the last have received special classifications, such as rustic buff and old Gothic; and there are still other grades that are grouped under the headings of special hard gray, special hard buff, and buff statuary stock.

In brief. Nature has been generous in thus providing a limestone that can be utilized economically to advantage in numerous ways, for service indoors and out. The quarryman is bringing into play the utmost of his skill, aided by power and mechanical facilities of many sorts, to place this material at the disposal of the architect and, through him, before the building public. What is being done to this end can be realized only by visiting the Bedford-Bloomington district, where astonishing things are performed, day in and day out, in getting the rock free from the primordial ledge and then in working it into more or less finished forms—many of them of great artistic elegance and beauty.

The chairman of the board of directors of the Indiana Limestone Company is Lawrence H. Whiting of Chicago. Mr. Whiting was active in carrying through the negotiations that brought the company into being, and in this he was supported by banking interests of Chicago, New York, and Cleveland. The president of the company is A. E. Dickinson, who previously was president of The Consolidated Stone Company. Mr. Dickinson has been an outstanding figure in the development of the Bedford-Bloomington limestone district for a quarter of a century. Other officers of the Indiana Limestone Company are: F. S. Whiting, vice-president and treasurer; F. E. Bryan, vice-president; T. J. Vernia, vice-president, in charge of sales; M. F. McGrath, vice-president, in charge of cut stone; and Nelson Joyner, vice-president, in charge of the quarry.

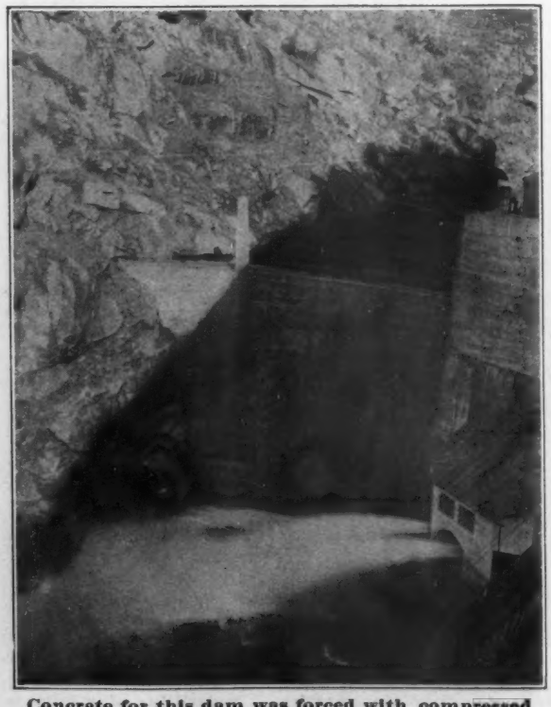
CALIFORNIA POWER PLANT HAS AFTERBAY DAM

THE Balch hydro-electric project, on the North Fork of Kings River, in California, is somewhat novel because of the special provisions made whereby power can be developed without interfering with the diversion of the stream flow for irrigating purposes. Therefore, the plant presented a distinctive problem to the engineers of the San Joaquin Light & Power Corporation.

Like many mountain streams, the North Fork of Kings River is extremely variable in its flow—at times being a swollen current and at other times scarcely more than a rivulet. The farmers entitled to use this changeable flow for watering their fields must enjoy a full measure of this water as nature would give it to them at different periods in the year. One can easily see that this requirement imposed difficult conditions upon the power-plant engineers, because the plant could not be operated efficiently if the water supply for the turbines were at all times in agreement with that of the stream, itself.

Accordingly, the engineers had to devise means by which the abundant flow of some seasons could be conserved for use during low-water periods and yet permit the diversion of all the water to which the farmers would have a rightful claim at any time. The solution lay in placing the power plant between two reservoirs of substantially identical capacities—one reservoir upstream from the power house and the other reservoir downstream from the generating station. The forebay dam impounds the water upstream, and the afterbay dam is downstream and impounds the water that has already driven the turbines. The flow of water from one reservoir to the other is subject to control from the power house, except such excess water as may run over the spillways during flood periods.

By this arrangement of reservoirs, the upper pond can be drawn upon for peak-load periods of operation in low-water seasons—the water so used in driving the turbines being discharged into the reservoir below, where it can accumulate and be turned into the irrigating system at a rate corresponding with the stream flow entering the upper reservoir. Without the afterbay dam and the afterbay reservoir, this balance could not be maintained, and both the farmers and the power company would be placed at a disadvantage.



Concrete for this dam was forced with compressed air through a 6-inch pipe line from the mixing plant, 700 feet above the stream.

The afterbay dam contains 7,500 cubic yards of concrete. It is 170 feet long at the crest, 75 feet high, 5 feet wide at the top, and 24 feet through at the base. The concrete required in the construction of the dam was mixed up on the mountainside 700 feet above the stream. From that mixing plant, the concrete was forced by compressed air through a 6-inch pipe to a hopper some distance below; and from the hopper the concrete was loaded into trucks and moved by them for a quarter of a mile to the dam site. The pneumatic transportation of concrete made it possible to mix the material at a convenient point and to deliver the concrete to the trucks where they could be carried over a well-built road to the dam site.

Utah will produce this year 1,470,000 bushels of apples, 640,000 bushels of peaches, and 86,000 bushels of pears. Most of this crop will be directly due to skillful irrigation.

Bridging the Colorado Across the Marble Gorge

By A. S. TAYLOR

WHERE the Colorado flows through a canyon 400 feet deep and 600 feet across from lip to lip, bridge builders are now hastening to completion a steel structure that will link roads on both sides of the gorge and add greatly to the convenience of vehicular traffic traversing this scenic wonderland. The Federal Government and the State of Arizona are footing the bill because of their reciprocal interest in the undertaking.

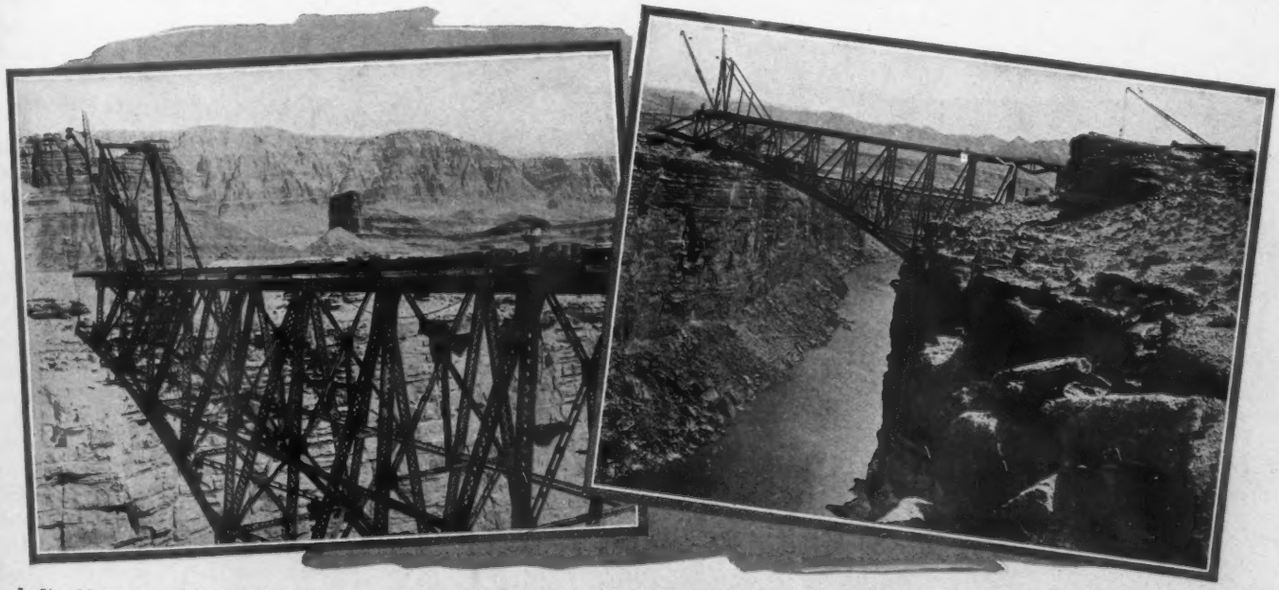
Compared with the massive proportions of the canyon, the bridge appears scarcely more substantial than a cobweb suspended across the yawning chasm; but, even so, it is going to rob the journey of the tourist of hazards that have exacted a grim toll on numerous occasions. The bridge spans what is known as the Marble Gorge, a 60-mile stretch of the restless and at times riotous Colorado lying between the points where the Paria and the Little Colorado empty into the bigger waterway. Between these limits the Colorado drops 400 feet on its run seaward, gathering velocity as it makes this descent through a succession of turbulent rapids.

The bridge, which will open a new route north and south for travelers bound between points in Arizona and Utah, will do away with the river crossing at Lees Ferry, which has been an active institution since 1871. The ferry rights were secured by the Mormon church about 1873 at a cost of 100 cows—the cattle being contributed by Mormon settlers in southern Utah and northern Arizona. Subsequently, the rights were acquired by Coconino County, Arizona; and in the years that have intervened that county has operated the ferry—toll being levied for the passage.

Jacob Hamblin, one of the picturesque pioneers of the Southwest, crossed the Colorado in 1860 on a raft during a comparatively quiescent period of low water. He made the trip with a number of companions; and the risks faced were such that they did not recross the river there on their return journey. By the time the Mormon migration was in full swing, in 1873, those emigrants found Lees Ferry the shortest route to their destination in the region beyond; but there were months running when the water trip could not be made at all, or, if made, involved great hazards. The peril has persisted despite the passing of time and the security of a cableway, run from shore to shore, by which to haul the ferryboat from side to side of the stream. Even within the present year, the ferryboat—carrying a party of motorists—overturned, and several of the passengers perished.

Before describing the new bridge, located about five miles below Lees Ferry, it might interest many of our readers to learn how Lees Ferry was so named. John Doyle Lee, who lived in enforced retirement at the ferry site for two decades, was once prominent among the Mormon leaders and was intimately and successively identified with Joseph Smith and Brigham Young. The Mountain Meadows Massacre, perpetrated in September 11, 1857, was an unprovoked attack upon a party of pioneers from Arkansas—the attackers being made up of Indians and renegade white men disguised as Indians. Lee was suspected of being one of the disguised whites; and to escape trial and possible punishment, so history has it, he suddenly disappeared from his accustomed haunts. He hid on one of the slopes of the Marble Gorge, where he built himself a habitation close by the crossing that afterwards was given his name. There far from any settlements, he probably thought himself safe from the long reach of the Federal authorities. In this he was mistaken, although he did live undisturbed in that secluded place for nearly twenty years—his existence being made varied, if not altogether tolerable, by the presence of a number of wives. In 1875, however, Lee was apprehended; and after two trials—the second ending in his conviction, he was taken to the scene of the Mountain Meadows Massacre and shot on March 23, 1877.

Lees Ferry is situated 130 miles almost due north from Flagstaff, Ariz., the nearest railroad station; and the highway north from Flagstaff connects at Lees Ferry with another highway leading north and west to Kanab, Utah. This route is unavailable, however, during the flood periods of the Colorado River, when the journey between Kanab and Flagstaff is lengthened hundreds of miles by a wide detour that must be made for the sake of safety. During high water the flow of the river is increased from a low-water discharge of 3,000



Left—Close-up of the first half of the steel arch projecting from the right side of the Marble Gorge. The tower and the derricks at the tip of the structure are serving to support steel cableways and to handle fabricated material that thus reaches the opposite side of the gorge for the building of the second segment of the arch. Right—Looking upstream from a point just below the bridge site. This side of the river has constituted the base of operations because it is nearer Flagstaff, from which all materials must be hauled a distance of 130 miles.

This cool-headed steelworker is not worried by the fact that the river flows more than 400 feet below him as he treads the narrow path of a girder flange.

second feet to a torrential discharge of 200,000 second-feet—the water mounting the while to a devastating level 40 feet or more above that of the so-called placid stage.

To reach the crossing at Lees Ferry, when the condition of the river is favorable, involves the passage of a narrow mountain road that traces its way down the face of the precipitous canyon wall. The journey is filled with a wealth of scenic wonders; but it is also full of dangers that call for a cool-headed and careful driver at the wheel of a motor car making the trip. It is not pleasant to think of what might happen if anything went wrong with the brakes! The road between Flagstaff and Kanab answers well enough for those that generally travel it. It is scarcely more than a desert trail, and is used for the most part by traders and Indians. With the completion of the bridge the road will be improved and made fit for automobile traffic; and when so brought up to date the route will, undoubtedly, become a popular one with touring motorists.

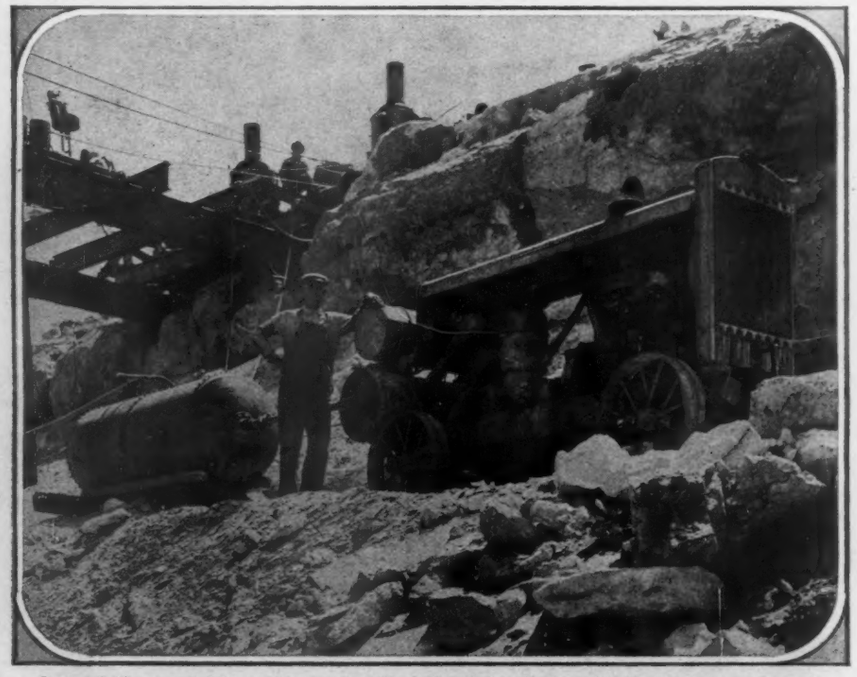
The Marble Gorge Bridge is being built under the supervision of The Arizona Highway Department at a cost of $341,000—Arizona providing $241,000 of that total. The $100,000 contributed by the Government was appropriated from tribal funds of the Navajo Indians in the keeping of the Federal authorities. The Indians are thus sharing in the outlay for a structure to bridge a chasm that their forebears were the first to penetrate by paths made by them so that they could reach the waters of the Colorado.

Architecturally, there is nothing distinctly novel about the Marble Gorge Bridge, even though the roadway of that structure will be 467 feet above the surface of the river when the Colorado is at low water. The bridge is what is described as the 3-hinged type, with battered trusses designed with reversal stresses for cantilever erection. From end to end, it will be 833 feet long—the main span being a deck arch of 618 feet. This arch will rest upon shelves cut in the solid rock of the canyon walls. The deck will have space for a reinforced-concrete driveway with a clear width of 18 feet between curbs.

A glance at the map will make plain some of the problems that have confronted the engineers. First, all structural materials and essential machinery had to be hauled from Flagstaff to the south rim of the gorge—a journey of 130 miles over a road that becomes well-nigh impassable in very wet weather; and, next, the southern half of the structure has had to be finished, or nearly so, before the first half of the bridge could be started on the relatively inaccessible northern rim of the canyon. Therefore, provision had to be made to so tie the northern half of the bridge to the rock well back of the rim with steel cables that the growing fabric could be held poised in space until the opposite companion section could be built southward to meet it midway across the chasm. In that position both segments of the arch could then be bound together with heavy steel pins.

By means of derricks, erected near the outer tip of the first half of the arch, cableways have been carried to the north rim of the gorge, and it is by these cableways that girders and other structural units of steel are being conveyed to the second anchorage for the fabrication of the northern half of the bridge. Sure-footed steelworkers are toiling aloft so intent upon their several tasks that they probably give little heed to the muddy, swirling waters of the Colorado far beneath them.

In excavating the rock for the anchorages, air-driven drills have been employed; and pneumatic tools of various kinds are playing important parts in assembling the fabricated steel units of the structure, itself. The compressed air needful for these services is supplied by portable compressors that had to cross the Painted Desert in order to reach the rim of the Grand Canyon. When completed, the bridge will be a gateway to scenic grandeur that beggars description. The span will make rich returns to the whole country on every penny spent on it; and on the projected connecting highways. They will enable us to visualize the remoteness of the past of this land of ours and to trace many of the stages of its evolution.



One of the portable compressors that furnish air for riveting hammers, rock drills, and other pneumatic tools used in excavating anchorages and in doing associate work in assembling the steel parts of the bridge.

Making Biscuits and Crackers For the Multitude

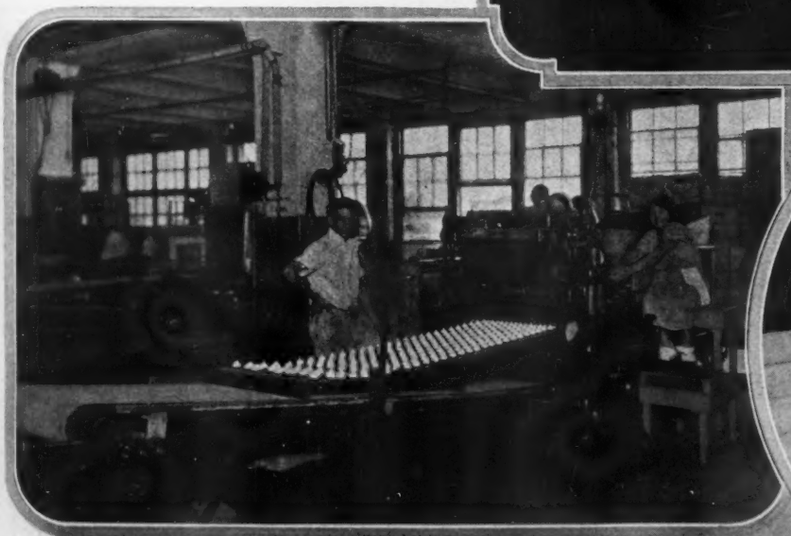
By J. S. MEEHAN

HUNGRY kiddies, discriminating palates, and hundreds of thousands of others that want something tempting and want it in haste, would be hard to gratify if they were now compelled to depend upon tasty things made by mother. Even if mother could and would do it, the demand is now too large and insistent to be satisfied by the baking methods that once upon a time prevailed in the average home. Today, we act upon the spur of the moment, and we either drop in upon our friends when they least expect us or we speed off to the woodland or to the seaside on pleasure bent—in brief, we go picnicking, and we must have goodies to take with us and enough of them to meet the requirements of sharpened appetites. This state of affair explains the prevalence of so many forms of package foodstuffs, put up so that they will retain a full measure of freshness for a fairly long period after they have been sealed in their containers.

Probably nothing is more indicative of this phase of the foodstuff industry, so to speak, than the crackers, biscuits, "sandwiches", and cakes now prepared on a wholesale scale and packed in air-tight cartons or packages and sold everywhere at attractive prices. These commodities are produced in many forms and so seasoned or flavored that they will meet all sorts and conditions of appetites —ranging from that of the invalid, who has to be coaxed, to the all-devouring hunger of the rapidly growing and robust youngster. The story we are going to tell has to do with the great plant in Long Island City, N. Y., where the Loose-Wiles Biscuit Company makes its 300 and more varieties of "Sunshine" products.

Because of the multiplicity of these products it might prove confusing and tedious if we tried to describe each of them and the manner in which it is manufactured. Therefore we shall confine ourselves mainly to the outstanding features of the great plant and to the broad methods employed in turning out a few of the company's toothsome commodities. We can give a suggestion of the volume of output by pointing out that a single machine, in the course of a day, will make 830,000 Sunshine soda crackers.

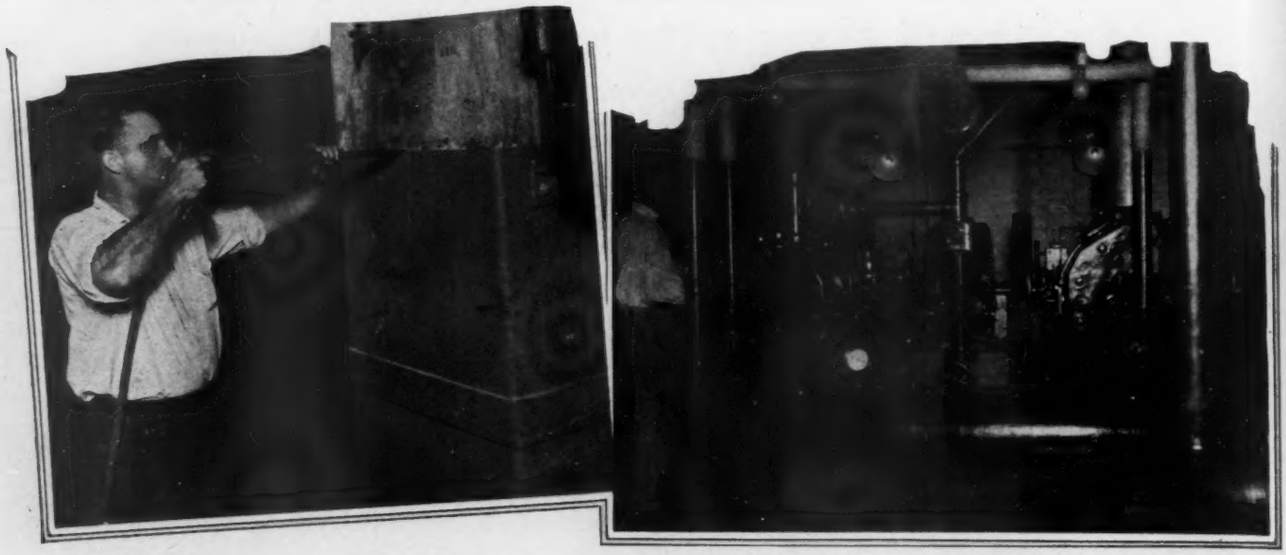
The Long Island plant is a 9-story structure



Top—This gas-heated machine is an aggregation of waffle irons and turns out the sugar wafers from which are made tempting "sandwiches" with a variety of fillings. The baking of these thin wafers takes about two minutes.

Left—A corner of the icing department where machinery is used to put the marshmallow filling on certain of the Sunshine dainties.

Right—Nimble-fingered girls placing the top biscuits on the marshmallow-filled "sandwiches." This is one of the few operations in the plant that must be done by hand.

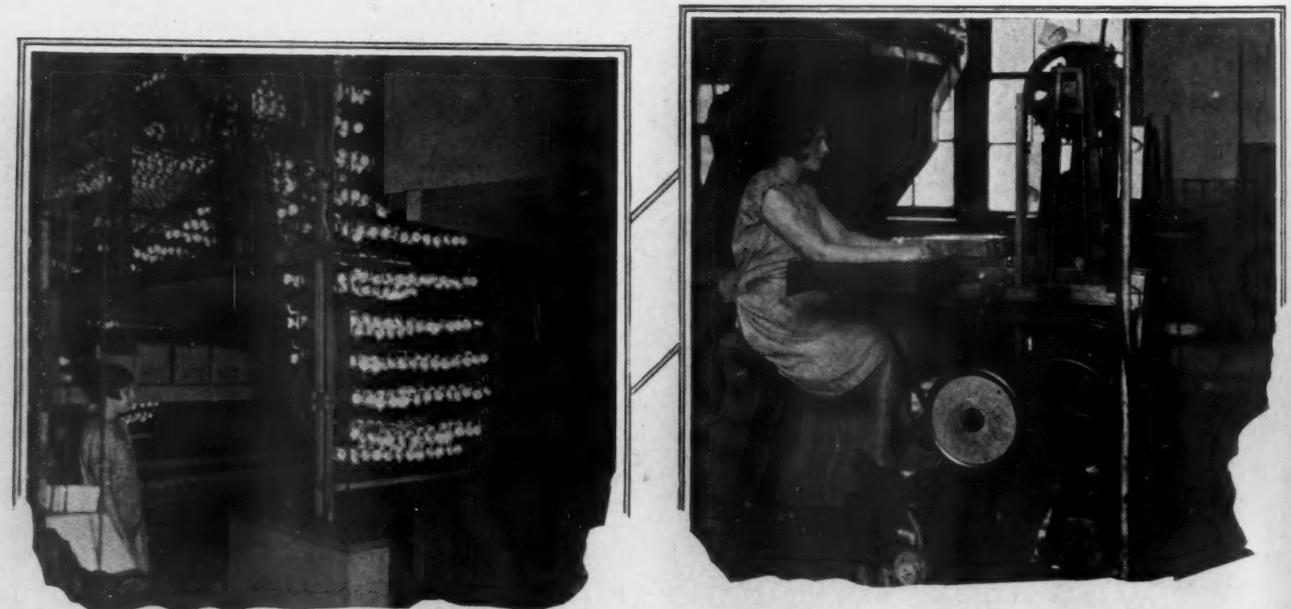


Left—Plant alterations and upkeep call for the frequent penetration of concrete walls and floors, and air-driven tools are utilized for this work. Right—All the air used in the Loose-Wiles Biscuit Company's plant is furnished by an XRE-2 compressor having a piston displacement of 676 cubic feet per minute.

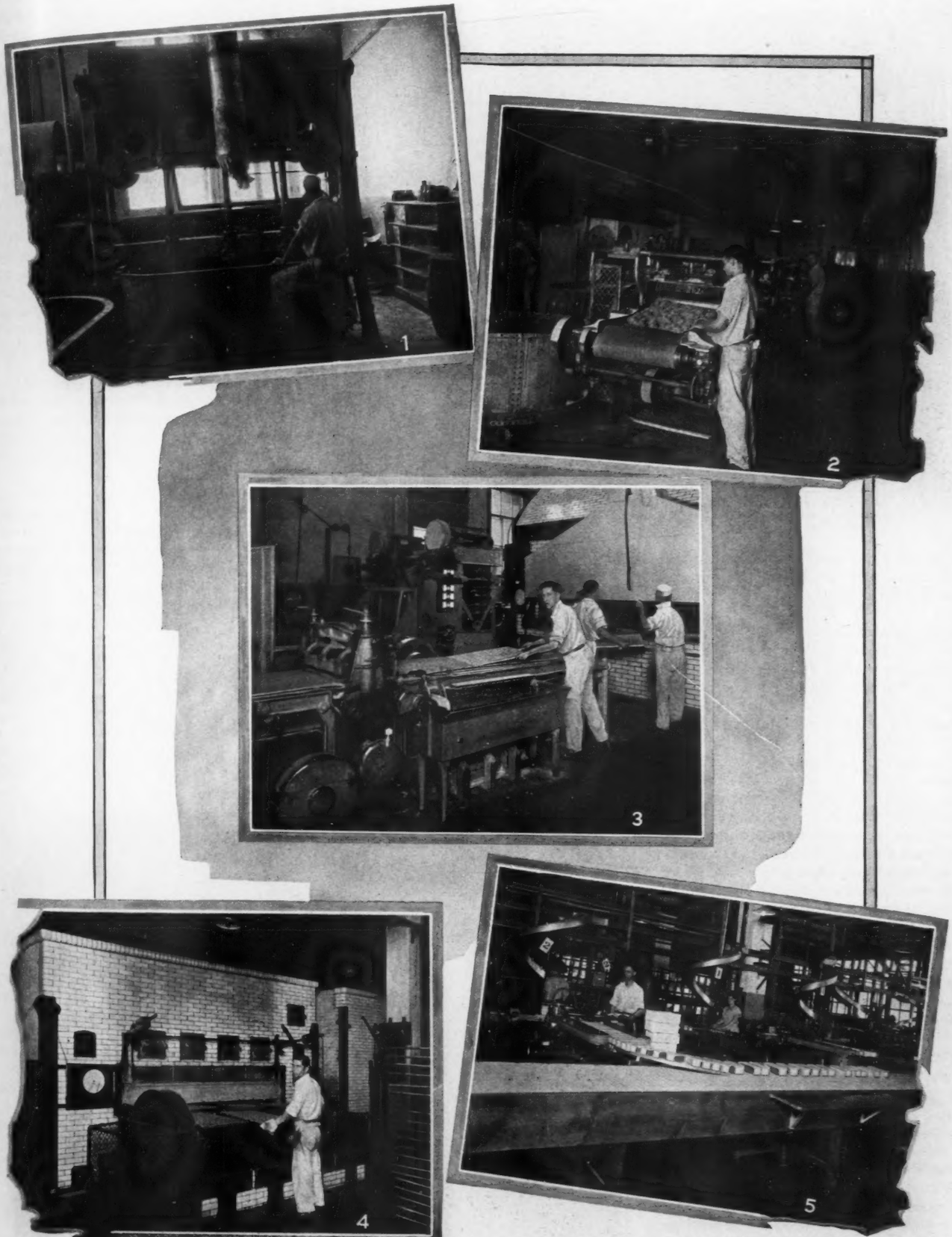
having available 843,000 square feet of floor space. The structure is of reinforced concrete and has a total dead weight of 72,000 tons—equivalent to about 1,000,000 cubic feet of concrete. To stabilize the ground on which the building stands, a matter of 13,500 piles were driven into the underlying earth. To equip it for the precise and speedy work for which it was reared, the factory has mechanical facilities of many kinds—the purpose being to insure uniformity in the commodities and to manufacture them very rapidly—in fact at a rate that arouses the wonderment of interested visitors. Even with all these mechanical aids, human hands and many of them are needed either to control the machines or to do those things that can best be done manually. To this end the plant employs more than 2,000 workers, who are actively engaged in turning out Sunshine commodities—the size of this force varying in accordance with seasonal markets.

Like many other manufacturing plants, operating processes start at the top floor and develop as the commodities are progressively treated during their movements downward to the lower floors, where the finished goods are packed, stored, or shipped, as the case may be. We must, therefore, begin our journey through the plant at the ninth floor so that we can follow through the steps by which goods are compounded, formed, baked and packed. The average housekeeper seldom uses more than two kinds of flour; but on the top floor of the Sunshine plant there is a commodious storeroom containing as many as 40 to 50 varieties of flour. This becomes understandable when we are told that some products call for as many as eight different flours in their make-up in order to give the marketable commodity just the right texture.

On the same floor there is a spice-grinding department where the air is redolent with cinnamon, allspice, ginger, nutmeg, etc.—reminding one at once of the days when cookies were made at home or something was going on in the kitchen that betokened the nearness of a feast. Upon the nicety with which these seasoning ingredients are blended depends the distinctiveness of the Sunshine goodies. On this floor, too, are pulverizing machines that powder each working day anywhere from 200 to 300 barrels of sugar. This powdered sugar is mixed with vegetable fats to form the



Left—Marshmallow-coated biscuits journeying back and forth in the drying room on a continually moving conveyor. Right—This skillful operator assembles the wax paper and the carton "flats" which are formed into lined containers by a motor-driven machine.



1—One of the numerous power-driven mixers that prepare large batches of dough for biscuit-making. 2—This composite machine rolls the dough into a blanket and then stamps it into biscuits at the rate of 830,000 in the course of a working day. 3—Skillful operators, with large thin wooden paddles, strip the biscuits from the moving belt as they come from the cutters. 4—Here we see trays of freshly baked biscuits issuing from an oven in which the heat is automatically controlled to a nicety. 5—These ingenious machines wrap the packages with wax paper, seal them, and apply labels better and faster than the work could be done by hand.

A spray of hot water and compressed air has been found highly effective in keeping clean the large fleet of motor vehicles operated by the Loose-Wiles Biscuit Company at its plant in Long Island City, N. Y.

base of the filling used with certain of the commodities. So much for the principal things that are done on the ninth floor of the factory.

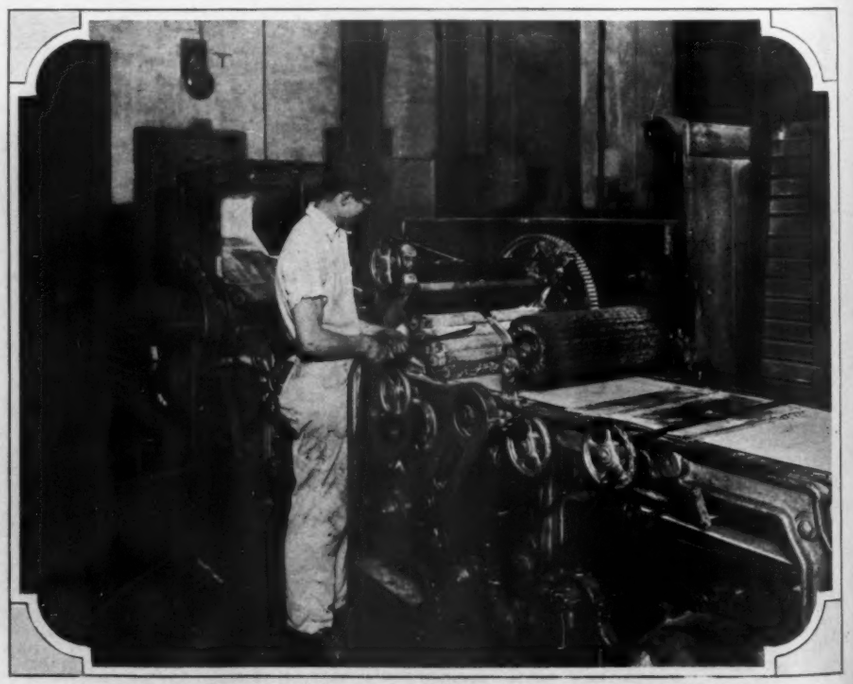
On the eighth floor, we get our first glimpse of how the different raw materials, after compounding, are worked into the shapes with which millions are familiar. Here we see the dough being rolled into a thin broad blanket by machinery and moved from these rolls beneath stamping machines that cut the dough into biscuits which go into the capacious and insatiable maws of numerous ovens—the biscuits passing through the ovens on sheet-iron pans. Depending upon the kind or nature of the product, the rate of travel through the ovens varies from two minutes to two hours. In the case of fruit cake—a commodity for which the Loose-Wiles Biscuit Company is noted—the journey through the oven takes an hour and a half in order to insure proper baking. The dies that stamp or cut out the biscuits just mentioned are apt to clog and to make imperfect impressions in the dough if they are not cleaned at short intervals. This cleaning is done with compressed air—the service line delivering air to the nozzles at a pressure of 100 pounds per square inch.

On the eighth floor there is also a cold room, where goods that require fat in their compounding are mixed. The vegetable fats and the molasses used there are delivered to the plant in tank cars and unloaded by compressed air—the oils or molasses being stored in tanks on the ground floor and raised thence to the eighth floor by rotary pumps. Upon leaving the ovens, the goods descend by elevator to the packing room; and during the trip they are cooled by blower air. There are 22 ovens in 2-row batteries on this floor.

In making wafers, the dough is forced through dies and takes the shape of sizable gum drops. These, in orderly array, go into the oven and come out as large as silver dollars. The shortening used contains butter, eggs, etc. The dough that becomes the "sponge" is mixed by machine, and then goes into a warm room—kept at a temperature of 80° F., where it remains long enough to rise. When it has risen, the sponge is removed from the warm room and worked up into the desired form or forms. Milk crackers—after they have passed through the stamping machines—are picked or stripped off the belt with a "peel" or long thin wooden paddle by a skillful operative who then throws them, while still preserving their order, onto the metal shelf or pan of the oven. It takes considerable practice to be able to do this without mussing up things and spoiling many biscuits.

We shall pass hastily through the seventh floor, because it is here that the ovens are fired and the atmosphere is higher than most of us like for a prolonged period. On the sixth floor are the machines that stack the freshly baked biscuits or crackers. On the trip from the ovens, on the eighth floor, the goods have cooled sufficiently to be ready for packing. The biscuits as they come from the elevators are picked up by suction acting through the perforations of a large cylinder; carried by that cylinder through a half revolution; and dumped on the far side by the automatic cutting off of the suction by means of an interposed baffle. As the biscuits are carried thence on a conveyor, girls pick them up in "lengths" and put them in boxes lying open at hand. These boxes or cartons are set up by machines from "flats".

From the floor above, the unsealed packages are delivered to the fifth floor by conveyors; and each package containing its particular goods is delivered to its own sealing machine. The sealing is done by "plugging" in the flap of each carton. From the sealing machines, the packages, in units of twelve, go to bundling machines which put on the wrappers and the labels. On this floor are made the sugar wafers for the so-called sandwiches which have won wide popularity. The wafer or waffle is baked in gas-fired machines—the baking taking about two minutes. The batter may contain chocolate, vanilla, fresh milk, and eggs. The filling is stenciled on the sheets of waffles, each of which is covered



A nozzle discharging high-pressure air used to clean rollers, dies, etc., clogged with dough.

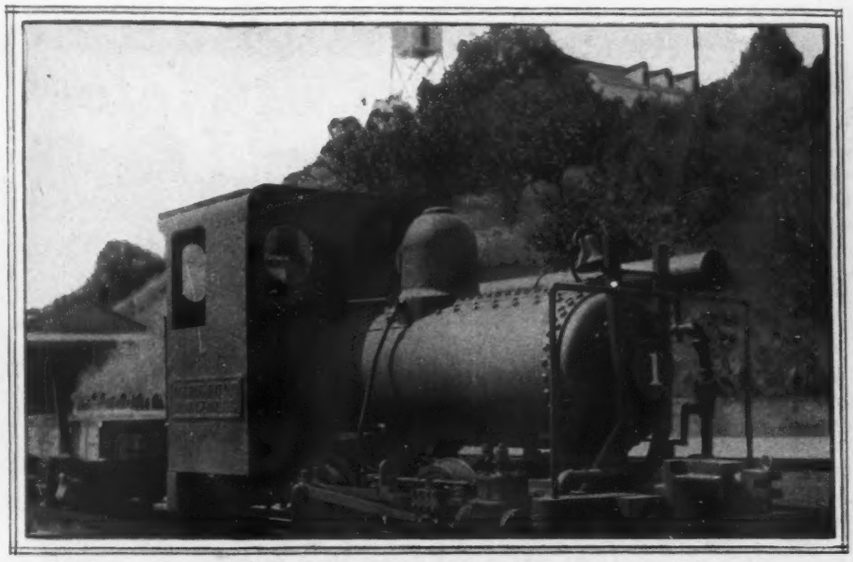
with another sheet and then run through a machine equipped with multiple circular saws—the little saws cutting the large sandwich into little ones of uniform length and breadth, all ready for packing.

The icing department is one of the outstanding features of the fourth floor; and here goods are given a variety of finishes calculated to gratify a wide range of tastes for sweets. The basic commodities, which may be cake or biscuit, are hung on the hooks of a conveyor and dipped and dried as they move onward. Their journey carries them through cold-air tunnels where the chill serves to slightly harden the marshmallow icing. Next, the goods may be covered with chocolate or finished with some other flavored coating, or they may be given a final layer of shredded coconut. When the marshmallow is coated with chocolate, the goods go to a cold room where they remain for a week before they are ready for the market. This period suffices to ripen or to soften the supporting cake and to effect a blend between the marshmallow and the unsweetened chocolate. The noticeable thing throughout the plant is the care exercised at every turn to reduce to a practicable minimum contact between the goods and the hands of the workers: cleanliness is insisted upon in each department.

The third and fourth floors contain stores of raw materials or stocks of finished commodities ready to be dispatched broadcast over the country. In the basement are cold-storage rooms in which are kept perishable ingredients such as figs, nuts, butter, gelatin, eggs, etc. In this way, these commodities can be kept absolutely fresh and prime up to the time of their being worked into the different products made at the Sunshine plant. Two ammonia compressors, having a combined refrigerating capacity of 225 tons, take care of the cold-storage compartments and of the other cooling requirements of the plant.

The compressed-air needs of the establishment are supplied by an Ingersoll-Rand compressor of the XRE type. Besides cleaning the biscuit machines and spraying some of the goods with butter, compressed air has a number of other services to perform about the plant. It blows cuttings from the engraving machines that fashion the bronze dies used to cut the biscuits; it cleans electric motors, of which there are 870 in the factory, as well as other machinery; it drives air tools employed variously in repair work and in remodeling about the factory; it operates paint-spraying apparatus; it helps to wash motor cars and to fill tires in the garage; and the fire-sprinkler system in the cold-storage department is a "dry" one—compressed air being the primary control medium.

The Loose-Wiles Biscuit Company's factory in Long Island City is only one of nine plants operated by that concern in different parts of the country—to be specific, in New York, Boston, Chicago, Minneapolis, St. Louis, Omaha, Kansas City, Dallas, and Pittsburgh. In all of them, the same general methods and mechanical facilities are available to meet the requirements of the territories served. In this way the output can be regulated to suit the immediate market and to insure a steady flow of temptingly fresh goods from the factories to the ultimate consumers. These products are now wax-wrapped; and this "keeps moisture out: keeps crispness in".



The compressed-air locomotive is the safest form of mechanical tractor for use in a magazine.

AIR-DRIVEN LOCOMOTIVE AT AMMUNITION DEPOTS

THE locomotive illustrated herewith is unique both in its size and its method of propulsion. It is a hustling, bustling, noisy little fellow whose motive power is compressed air. At certain of our Government arsenals and ammunition depots, where high explosives are continually handled, it is obviously extremely hazardous to use any kind of locomotive that might ignite inflammable substances. To obviate this danger, air-operated locomotives are utilized.

This compressed-air locomotive is pulling a load of explosives.

The locomotive shown is of the type in service at the United States naval ammunition depots for transporting high explosives within the confines of the depots. It is a compact little fellow, and bears about the same resemblance to its big brother, the freight locomotive, that a midget does to a full-grown man. The driving mechanism, and the cab, brakes, coupling apparatus, etc., are practically identical in design and pattern with those of a steam locomotive. The cylindrical body or "boiler" is the air flask, in which enough compressed air at high pressure is stored to run the engine several hours. When the air in the cylinder is exhausted, the flask is recharged from an air compressor or from compressed-air banks.

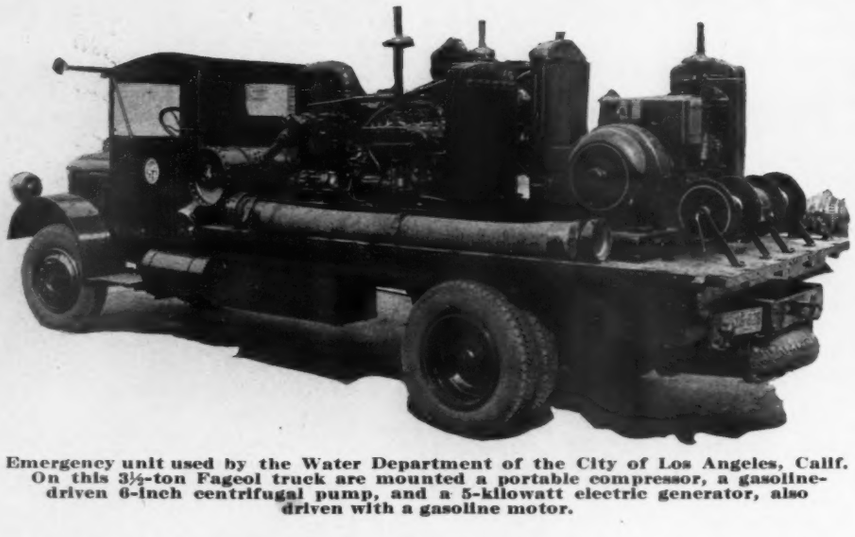
ELECTRIC FIELD HALTS FISH

TO keep fish from trespassing, and for their protection as well, an engineer for a Pacific coast power company has conceived a scheme that effectually prevents the destruction of these creatures by turbine wheels. The invention is the first of its kind, says the Oregon State Fish Commission, to be used with success, and consists of two parallel rows of electrodes suspended from a wooden framework above the water. The electrodes are held at approximately the same level near the bed of the stream, and set up an electric field that is of equal strength from the surface of the water down to the bottom and that tapers off upstream and downstream in proportion to the distance from the center of the field.

When a fish approaches the tailrace, and swims into the edge of the electric field, it may immediately be turned back by a shock. Or, if it attempts to go farther, it will receive a still greater shock that discourages progress. A field current of from three to four volts is sufficient to divert a 30-inch salmon, and will, it is claimed, do the fish no harm even should it pass through the entire field. These devices have been installed at the various dams of the California-Oregon Power Company.

Manysided Mobile Emergency Plant

A KNOWLEDGE of requirements, coupled with resourcefulness, is frequently productive of special equipment, and this is strikingly brought out in the case of an emergency wagon or plant designed and built by F. M. Van Deventer, general foreman of the Ducommun Shops of the Los Angeles Water Department, for use by that department.



Emergency unit used by the Water Department of the City of Los Angeles, Calif. On this 3½-ton Fageol truck are mounted a portable compressor, a gasoline-driven 6-inch centrifugal pump, and a 5-kilowatt electric generator, also driven with a gasoline motor.

This emergency wagon, a 3½-ton Fageol motor truck, carries a 5½x5-inch, Type Twenty, Ingersoll-Rand portable compressor with a capacity of 110 cubic feet of free air per minute; a Byron-Jackson 6-inch centrifugal pump direct connected to a Hercules gasoline engine; and a Kohler electric plant, direct connected to a Waukesha motor, producing 5,000-watt, 110-volt direct current. In short, on four wheels is carried all the equipment necessary—in case, for example, of a leak in the main water-supply line—to break up the overlying pavement, to pump the water, and to provide electric power used, among other things, to light the scene of operations if the work must be done during the hours of darkness.

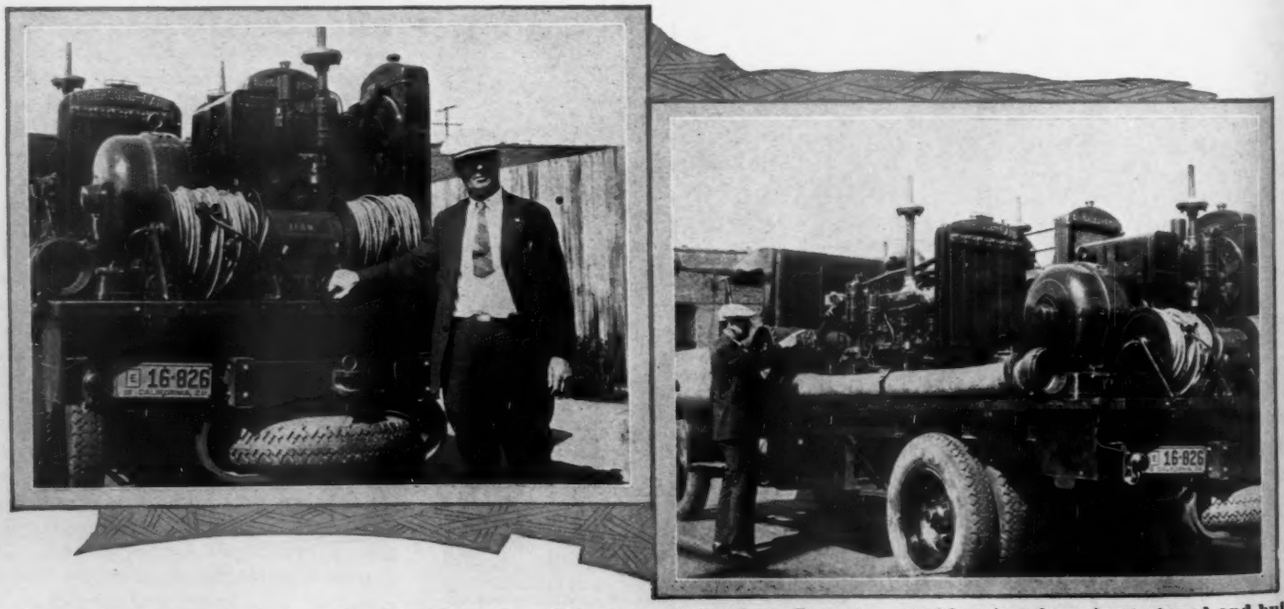
The Los Angeles Water Department has found this 3-unit plant invaluable in answering "hurry-up calls"—that is, in emergencies where service cannot be discontinued except for short intervals at night—and also in connection with its pipe-laying activities. For this work, the air furnished by the compressor, mounted on the truck, is employed to operate chipping hammers that serve to cut fittings and cast-iron piping; clay diggers to remove the earth from the trench in which the pipe is to be placed and to excavate bell holes so that the men will have room enough to calk the joints; riveting hammers when a joint is to be made; and concrete breakers to break up the pavement.

The pump is capable of handling 1,400 gallons of water per minute, sufficient to drain a ditch or hole while a connection or repairs are being made; and the electric plant takes the place of the old-fashioned and comparatively dim lanterns formerly used when artificial light had to be called into service. Now two 2-wire cables, each 350 feet long and wound on separate reels, are strung on both sides alongside the ditch as far as needful, and 100-watt lamps, at 15- or 20-foot intervals, turn night into day. This plant is automatic in its operation—being disconnected when the last light on the line is turned off.

At the time of the Water Department's worst catastrophe, the breaking of the St. Francis Dam, this truck was called into action at once. With the break went 400 feet of the well-known Los Angeles Aqueduct—a main 11 feet in diameter and running in part through the Dry Canyon Tunnel. On that occasion it served a twofold purpose—that is, it was used for lighting while reconstruction work was in progress and for pumping water through to other points so as to maintain the necessary supply.

In its brilliant coat of red embellished with gold, this emergency wagon has become a familiar sight in the streets of Los Angeles; and it has rendered such a good account of itself in the short time in which it has been in service that the water department of that city would feel seriously handicapped without it.

It has been estimated that the manganese deposits discovered near Postmasburg, South Africa, contain 500,000,000 tons of that mineral.



Left—Mr. F. M. Van Deventer, general foreman of machine shops of the Water Department of Los Angeles, who designed and built the emergency unit. Right—Mr. Van Deventer calling attention to certain features of the portable compressor.

Use of Compressed Air Increasing In Metal Mining

Presentation of Some of the Factors Bearing Upon the Selection of Mine Compressor Plants

PART II

By MORGAN H. WRIGHT

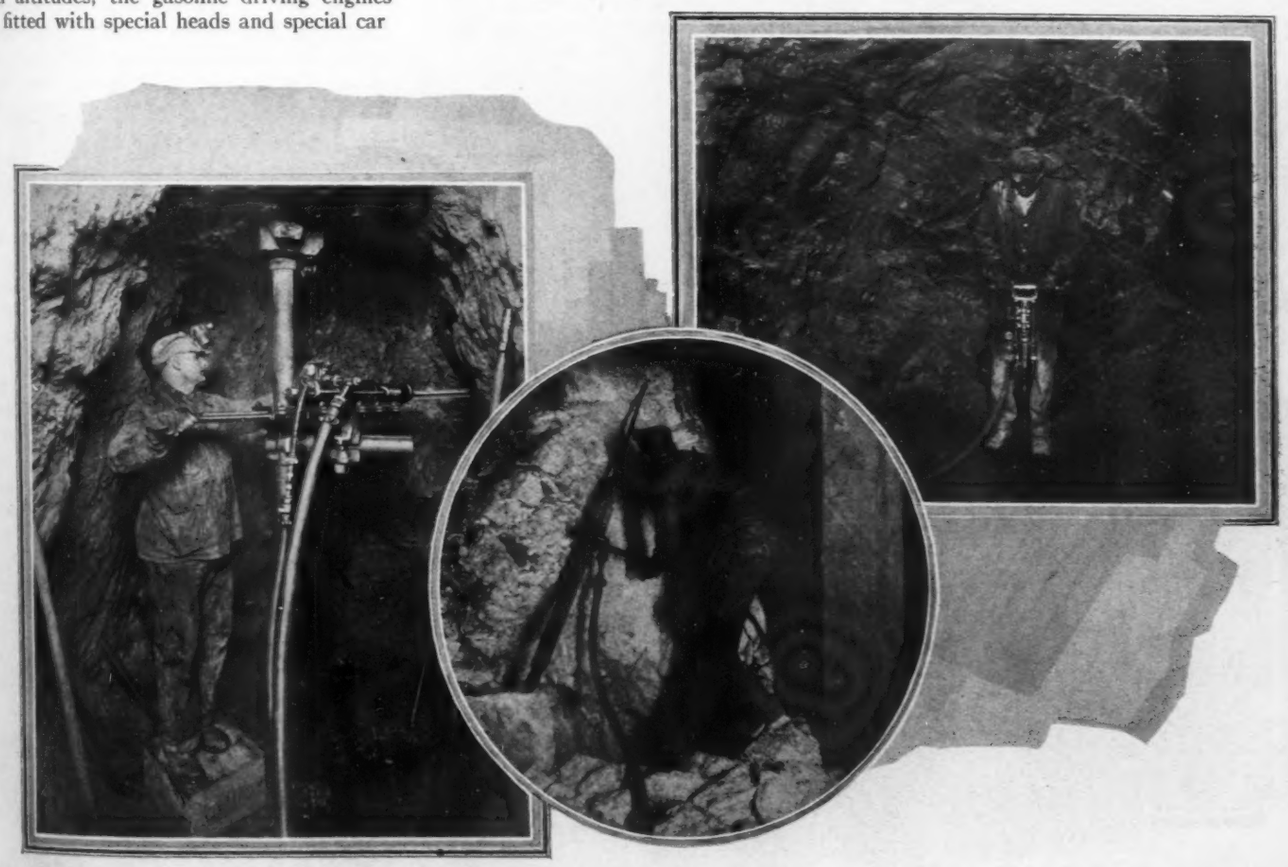
WE shall now consider suitable accessory equipment for conditioning the air and for directing it to the points of use. Before leaving the subject of compressors, however, we shall refer briefly to the advantages that the portable compressor offers in developing prospects and small mines. The mining industry is utilizing gasoline-engine-driven units of this type successfully not only in this country but in Canada, Alaska, India, Australia, and in other mineral-producing sections of the world. Being mounted on wheels, machines of this type can be moved readily into remote areas. Since they are self-contained, they are ready to start work immediately, and no installation expense is entailed. In many cases they constitute the sole power plant available, and suffice to operate rock drills, hoists, pumps, and other equipment.

To increase their operating efficiency at high altitudes, the gasoline driving engines are fitted with special heads and special carburetor jets. By carefully planning the daily schedule of drilling, hoisting, pumping, steel sharpening, etc., these small compressors will prove adequate for fairly extensive exploration work. Except for short-time service, or for rush work, they are not applicable to operations requiring more than 300 cubic feet of air per minute.

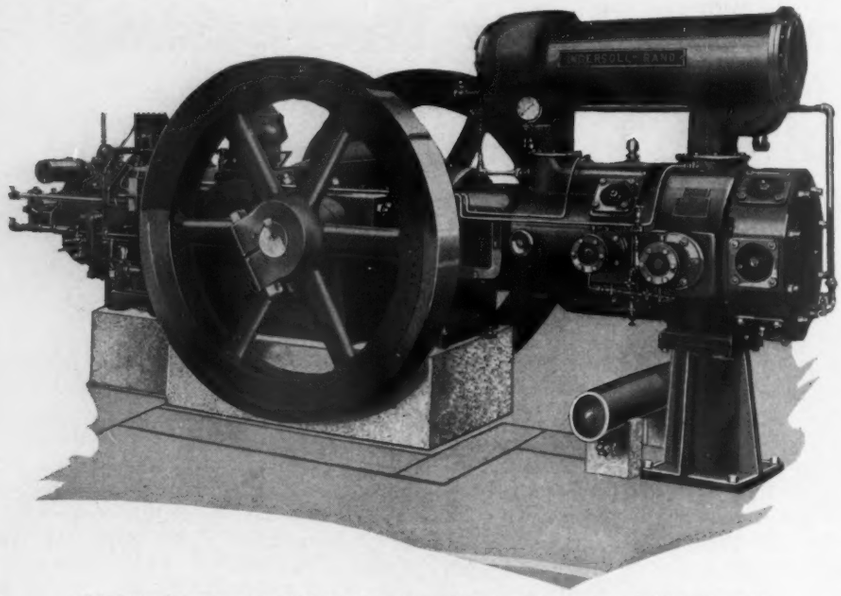
Earlier in this article we urged for a given property a permanent air plant capable of supplying a maximum of about 1,800 cubic feet per minute. We said the best engineering practice was to have two compressors, one of 600 and the other of 1,200 cubic feet per minute, rather than one machine of 1,800 cubic feet capacity. We must now plan for aftercoolers, receivers, and pipe lines that will distribute the air to points of consumption above and below ground.

The function of the aftercooler is to extract the surplus heat of compression and thereby to remove excess moisture. This is accomplished by means of circulatory water. The need for such treatment becomes obvious when we know that a 2,000-cubic-foot compressor, running at capacity for eight hours on intake air having a temperature of 82° F. and a humidity of 75 per cent, will take in about 1,200 pounds of water vapor with the air. When condensed, this amounts to three barrels of water.

The location of the air intake of compressors also affects the heat and moisture content of compressed air. The intake should be placed where conditions aid in obtaining a supply of clean, cool, dry air. On this point *Compressed Air Data* informs us: "It is common practice to take air from the engine room directly into the compressor intake. This is inadvisable for many reasons. There is scarcely a situation



Pneumatic rock drills can be counted upon to do their work well only when their runners are assured a continuous supply of compressed air at a suitable pressure.



Many mines are located where oil-engine compressors would be found economical sources of operating air.

to be found where it does not pay to draw the air from outdoors, instead, because the average outdoor temperature is considerably below that of buildings. Examples will best explain the actual economy obtainable by taking the air from outdoors.

"Irrespective of the outside temperature, the compressed air in a shop pipe line will be nearly the temperature of the room by the time it reaches the tools. Assume the average indoor temperature to be 60° F. If the compressor takes in 1,000 cubic feet of free air directly from the room, it will also deliver 1,000 cubic feet of free air at the tool, because the final temperature is the same as that at the intake. Suppose the outside air averages 40°F. If the compressor is supplied with intake air from outdoors, only 961.5 cubic feet will be required to deliver 1,000 cubic feet of free air at the indoor temperature—a direct saving of 4 per cent. The colder the climate, the more pronounced this effect becomes. If the compressor is supplied with intake air from an engine room where the temperature is 100°F., then 1,080 cubic feet will be required to deliver 1,000 cubic feet of free air at the indoor temperature of 60°F. An actual case is recorded where, without a cold-air intake duct, 1,500,000 cubic feet of free air delivered was costing $43.96 per day. After installing the intake duct the cost was $40.42 per day, an annual saving of $1,062."

Atmospheric air always carries with it a certain amount of dirt. Air need not look dirty to be dirty. In one week, an 1,800-cubic-foot installation will draw in from 3 to 10 pounds of dirt with the air, even though the compressor intake is located in a so-called clean place. This dirt is, of course, abrasive; and if allowed to enter the compressor it will cause wear and will shorten the life of the unit appreciably. There are now on the market a number of air filters to be connected to the compressor intake. Certain of these are extremely efficient—removing more than 98 per cent of the dirt in the air. The use of an air filter of this type is to be recommended for all compressors. It will pay in the long run.

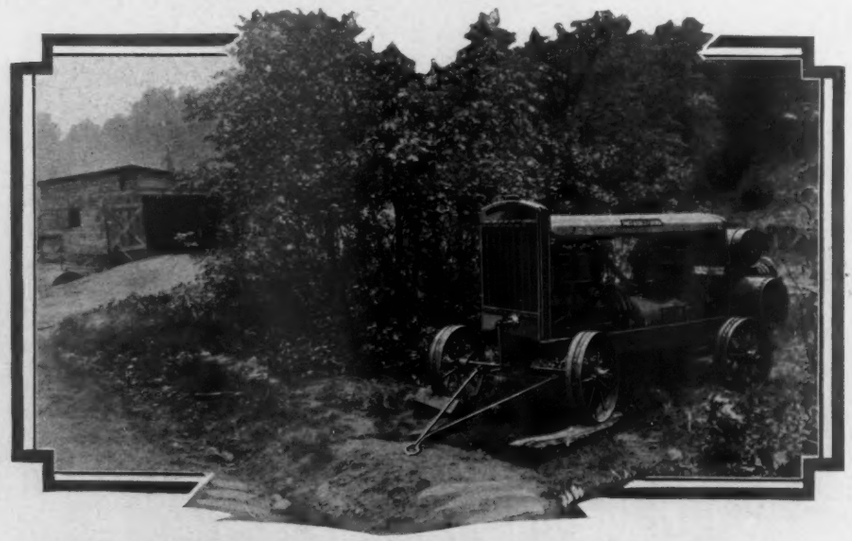
The rule for determining the size of the intake is that it should have an area of not less than 50 per cent of the area of the compressor piston. If the intake pipe is long, its diameter should be increased one inch over the size at the compressor for each 10 feet of length.

The air receiver should have a capacity at least equal to the output of the compressor plant for one minute. As 1,800 cubic feet of free air per minute is equivalent to about 230 cubic feet of compressed air at 100 pounds pressure, the receiver for the compressors we determined upon should hold at least 230 cubic feet. It should be placed outdoors close to the compressors but following the aftercoolers, and preferably on the north side of the building so that it will benefit by the cooling influence of the shade. This cooling aids in further precipitating the moisture in the air. A second receiver of smaller size should be installed at the lowest point in the mine to equalize the demand on the air lines and to trap any remaining moisture that may condense in the air mains in cool weather.

In planning the air mains for the mine we assume that there is but one shaft or tunnel. To obtain the best possible results, we should deliver the air at not less than 85 pounds pressure to the drifter drills; at 80 to 85 pounds to the automatic rotating stopers in hard-drilling ground; and at 75 pounds to the hand-rotating stopers and "Jackhamers" in average ground and at 85 pounds in excessively hard ground.

If the distance from the receiver to the shaft collar is 300 feet, and that from the collar down to the first workings is 500 feet, a 5-inch main line will be adequate, as the pressure drop will be only about 3 pounds. For 1,000 feet additional the drop will be only about 4 pounds more. The mains to the levels and the branch lines leading from the mains to stopes and raises will be planned according to existing friction tables and to the number of drills to be served. Due allowance must be made for pressure losses so as to insure adequate pressures at the drills. Incidentally, it is worth noting that pressure losses due to friction are much greater when the air flow is pulsating. It is therefore quite important that pulsating flow tables be employed in deciding on the sizes of the air hose to be used with the drills.

It is well to bear in mind that even the smallest leaks in air lines cost money. A total of 9,979,200 cubic feet of air at 100 pounds pressure will escape through a 3/8-inch opening in one month. The cost of compressing this volume of air is about $1,000. At one property, where a test was made, the entire output of the compressors, which developed 200 hp. with all regular outlets closed, was consumed by leaks.



Portable compressors often prove invaluable aids in the early stages of opening up a mining property.

Crushed-Stone Plant Proves Operating Economy Possible

Harry T. Campbell Sons Company, Inc., Find Oil-Engine Drive A Source of Substantial Saving

By A. S. TAYLOR

POWER, plenty of it, at a reasonable cost is nowhere needed more than in the crushed stone industry. This is true not only because of the nature of the raw material that must be reduced to marketable sizes but because of the variableness of the load factor during the operating period of every working day. A source of power must, therefore, be available to meet this shifting range of demand; and the present article tells how one enterprising producer of crushed stone has met and solved the problem to his satisfaction.

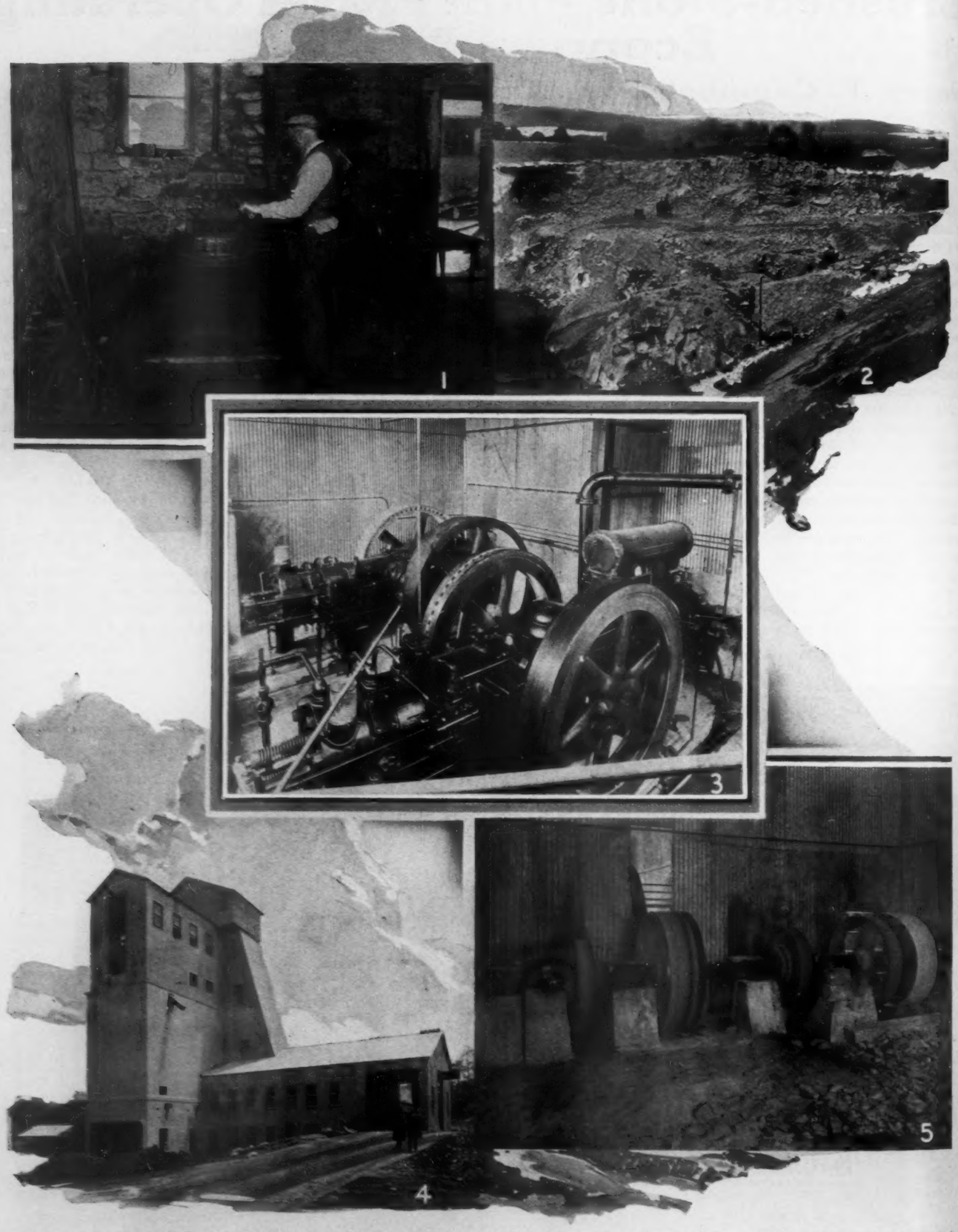
As is generally known, crushed stone is in steadily increasing demand both for road-building and for structural concrete work of many sorts. Quarries efficiently equipped to meet existing conditions are organized in a way that differs radically from the crushed-stone plant of but a decade back. Quantity production, standardized output, and operating economy in the face of growing competition have, conjointly, brought about the altered aspect of the up-to-date quarry and its associate mill. Aside from a convenient source of satisfactory rock, the prime movers of such an undertaking must be of a dependable type and low in their cost of operation. It has, therefore, occurred to us that there are among our readers many that would like to know how the Harry T. Campbell Sons Company, Inc., of Towson, Md., has equipped its new mill at Texas in that state.

The Harry T. Campbell Sons Company, Inc., has a business background of nearly 40 years; and what it has done in equipping its plant at Texas is the outcome of a ripe and cumulative experience marking many stages in the development of the industry. Back in 1892, Harry T. Campbell began the quarrying of stone to furnish ballast for a horse-car line traversing the Harford Road in Baltimore. The business was conducted on a modest scale. Subsequently, as the demand developed, Mr. Campbell opened up other quarries—each of them being at some suburban point where he could provide crushed stone to contractors having work in hand within easy hauling distance. The market for his stone became larger with each passing year.

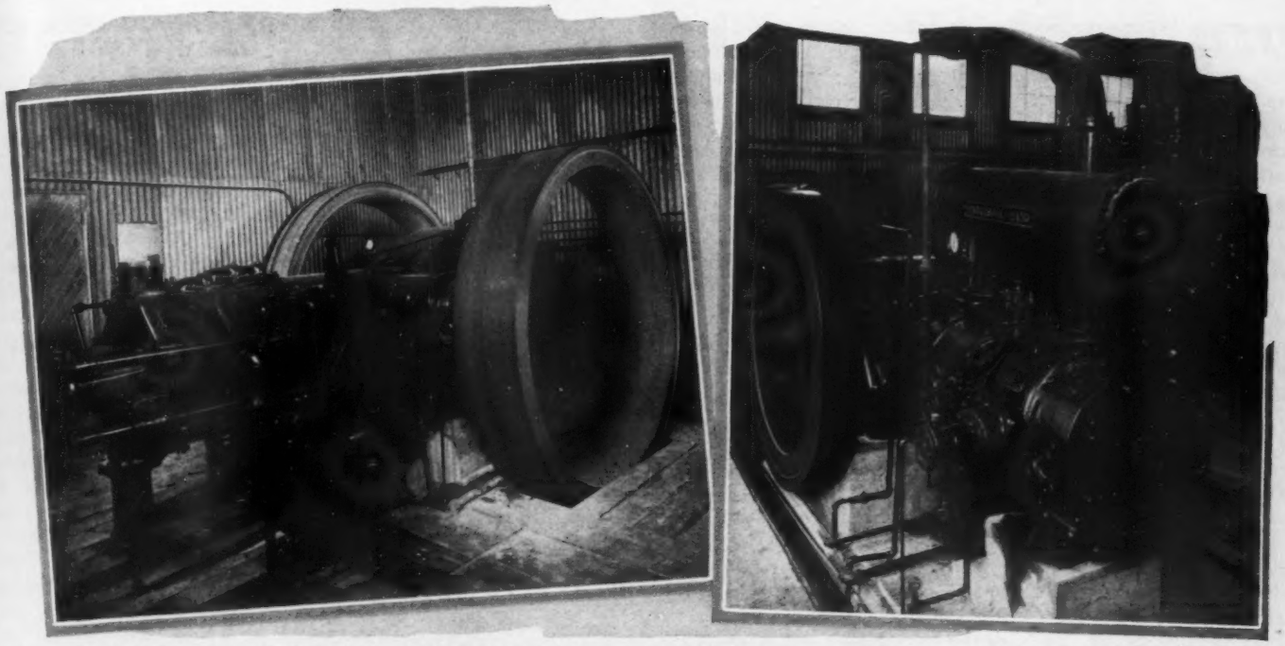
In 1919, a quarry was opened on the York Road at a point twelve miles outside of Baltimore, and there a plant was called into being large enough to turn out 400 tons of crushed stone daily. From then on until very recently that quarry was the main reliance of the company as a source of raw material. Harry T. Campbell, the founder of the business, died in 1922, and shortly afterwards the business was incorporated under its present title—that is, Harry T. Campbell Sons Company, Inc., with headquarters at Towson.

Prior to 1919, the company had been engaged in the contracting business and had been occupied especially in roadbuilding and in various kinds of heavy concrete work—all the while furnishing crushed stone to other contractors. Suitable as the plant on the York Road was in some respects, still it had one serious drawback. It was without direct railway connection. This lack was emphasized

Top, left—In the quarry at Texas, Md. Center—Elevator on north side of crushing plant. Right—Block-holing large pieces of rock with "Jackhamers". Bottom, left—Steam shovel loading trucks in the quarry. Right—Blacksmith shop adjacent to the crushing plant.



1—The air-operated "Leyner" sharpener that takes care of the drill steels used in the quarry. 2—The quarry, showing part of pit not yet unwatered. 3—General view of engine room in stone-crushing plant. 4—This stone-crushing plant is capable of handling 175 tons of rock an hour. 5—The main-line shaft which is belt-driven by a 150-hp. Ingersoll-Rand oil engine.



Left—The 150-hp. Ingersoll-Rand oil engine that is the prime mover in the stone-crushing plant. Right—This POC-2 oil-engine compressor furnishes air for the quarry and for other uses about the crushing plant.

when the activities of the company broadened and the market for its stone widened greatly—nearness to a fine and much traveled highway being only a partial solution of the difficulty.

During 1926 and 1927, the Campbell Company had on its hands so many contracts for work in its chosen field that its York Road quarry and plant could not meet more than half way its own needs in crushed stone and permit it to sell, at the same time, to a restricted number of its older customers. Confronted with this situation, and feeling still more keenly the lack of rail contact, the company wisely decided to abandon the York Road plant and to reëstablish itself where it could have a dependable source of raw material and be adjacent to a trunk line. The new mill—which began operating this spring—is located at Texas on the Harrisburg branch of the main line of the Pennsylvania Railroad; and close by is the quarry from which is obtained an excellent grade of blue limestone. The quarry is on a property about 200 acres in extent.

When the Campbell Company came into possession, the quarry was flooded, and had been in that condition for years following its abandonment as a source of limestone for numerous quarries worked previously in the neighborhood. The task of unwatering the quarry was happily achieved in a fairly simple way by mounting an 8-inch centrifugal pump, motor driven, on an improvised raft of empty tar drums. By operating the pump steadily for 30 days running it was possible to get rid of 60,000,000 gallons of water. This sufficed to uncover a working face about 800 feet long having a maximum height of 70 feet.

The stone now mainly worked is a 40-foot stratum of close-grained dolomitic rock, lying beneath a 6-foot overburden. Immediately below the blue limestone there is a stratum of crystalline limestone—30 or more feet in thickness—containing on an average 99 per cent of calcium carbonate. This unusually pure limestone is quarried to a very limited extent, and is sold for special purposes. The upper stratum of blue limestone meets both State and Government specifications for road use; and it is a thoroughly satisfactory material for concrete aggregates.

In getting out the rock, the company employs a bench method that proved quite efficient in the former quarry on the York Road. All drilling is done with "Jackhamers" utilizing steels ranging from 2 feet to 12 feet in length; and the blasted rock is loaded into motor trucks by a steam shovel that has a ¾-yard dipper. Each motor truck has a capacity of 10 tons, and is fitted with a special steel body so that it will be rugged enough for the exacting service to which it is subjected. The trucks are provided with a power gear so that their bodies can be tilted for tail-end discharge. Between the quarry and the crushing plant there is a broad concrete-surfaced road. This is well, because the grade is a stiff one. Motor-truck haulage, in this instance, is undoubtedly the best and the most economical way to move the rock from the quarry to the crushing plant.

The stone-crushing plant was designed by Soule & Zepp, Inc., consulting engineers, of Baltimore, Md.; and we are indebted to those gentlemen for many of the particulars contained in this article. The de-

Left—Loaded truck emerging from beneath stone bin. Center—Loading stations for railway cars and motor trucks. Right—Loaded truck carrying rock to crushing plant.

signers were called upon to provide a plant that would prove economical to operate under a widely varying load, and to choose a form of prime mover that could be counted upon to make possible the savings desired by the Harry T. Campbell Sons Company, Inc. The mechanical arrangement is such that the load on the main power unit ranges during the working day from approximately 25 per cent to full load. This is understandable, because there is an interval between the unloading of succeeding trucks; and the crushers may, at such times, be idle for periods of several minutes' duration. Similarly, the elevators, belt conveyors, screens, etc., may run idle or with only partial loads during certain intervals. With these conditions to be met, the designers decided upon an oil-engine installation; and, accordingly, an Ingersoll-Rand PO unit, of 150 hp., was purchased.

That engine drives all the equipment of the crushing plant, as well as a generator for lighting service. The engine is belted to a main-line shaft, and nearly all the plant units are, in their turn, belt driven from this line shaft. The only exceptions are the main elevator and the main sizing screen, which are driven by belts through countershafts. Compressed air for running rock drills in the quarry, for operating a forge and a "Leyner" sharpener in the blacksmith shop, for cleaning motors, etc., and for some other purposes is furnished by an oil-engine-driven compressor of the POC-2 type. The oil-engine end of this unit is of 110 hp. The compressor is so placed in the engine room that it can be belted to the main-line shaft for use in an emergency.

The compressor engine can, therefore, be utilized to operate the main plant as far as 110 hp. will serve for that purpose; and the main engine or the engine of the POC-2 unit can be employed, as circumstances determine, for running the stone-pulverizing plant forming one of the departments of the mill. Ordinarily, the pulverizing plant works only at night-time when the crushers and the quarry are closed down. Without going into further detail, enough has been said to make plain the flexible nature of the power plant and to show how the mill can be run with either oil-engine prime mover—thus obviating a shutdown if one or the other of the units should be momentarily halted for some reason.

At the time the Texas plant was visited, the mill and the quarry had been in operation for only a few weeks. The engineer's log showed that the 150-hp. oil engine had been consuming on an average 3.93 gallons of fuel oil per hour—the Ingersoll-Rand Company's guarantee being 8.4 gallons per hour at full load. The oil consumption of the POC-2 unit had averaged 3.48 gallons per hour, and was then maintaining, in the service line, an air pressure ranging between 85 and 90 pounds per square inch. The Ingersoll-Rand Company had guaranteed a consumption of 6 gallons of fuel oil per hour at full load when operating against a discharge pressure of 100 pounds per square inch. The performances of the prime power unit and the oil-engine compressor have been economical and entirely satisfactory to the management. In fact, these machines have shown themselves especially suitable for the service expected of them.

The crushing plant and the oil engines are in adjacent rooms in the mill. The main clutch, interposed between the engines and the crushing plant, can be operated from a platform on the truck-runway level in the crusher room; and from that position the operator commands a full view of the truck driveway, the crushers, and the main elevator raising the stone thence to the main rotary sizing screen on the floor above.

The loaded trucks discharge into a hopper from which a No. 25A Telsmith crusher is fed. From this crusher the stone goes directly into a rotary scalping screen—oversize stone being delivered first to one or the other of two No. 10A Telsmith crushers and then right to the elevator. All stone that passes through the holes in the scalping screen drops on to a 32-inch bucket elevator which discharges into a hopper that feeds a Galland-Henning rollerless rotary screen. Chutes under this sizing screen are so arranged that stone of any desired size can be obtained; and flap valves on each of these chutes make it practicable to regulate the flow of the crushed stone so as to get a mixture to meet any given requirement.

The plant is equipped with batchers, placed below the storage bins, so that aggregates can be proportioned, discharged into waiting trucks, and then delivered to concrete mixers on the job without the need of any further handling. This equipment has already led to substantial operating economies. All told, the extremely small force of four men is ample to take care of the crushing plant, the power plant, and the truck-loading equipment. As Messrs. Soule and Zepp have expressed it: "With all the units of the plant installed, every pound of stone entering the plant will be utilized and reduced to a salable product."

The Texas mill began operating early in April of the present year. The plant was designed for a daily output of 1,200 tons of crushed stone during a 10-hour day. In practice, it has been running at the rate of 175 tons an hour, still keeping well within the prescribed margin of safety. Even so, this sizable and up-to-date plant will scarcely be able to meet the needs of the Campbell Company, let alone provide crushed stone for other contractors. The company's undertakings have multiplied latterly to an unforseen extent—all of them calling for considerable quantities of crushed stone. Among these recent jobs is a contract for a large reinforced-concrete reservoir. This situation warrants comment because it shows how a spirit of accommodation and the turning out of an excellent product well-nigh always win recognition.

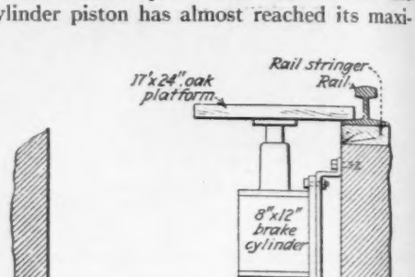
The officers of the Harry T. Campbell Sons Company, Inc., are: Bruce S. Campbell, president; Harry Guy Campbell, treasurer; and Miss F. S. Campbell, secretary.

Plans are underway for the construction in Kobe, Japan, of an underground railway.

CHANGING CAR COMPRESSORS MADE EASY

AT THE Woodside shop of the New York & Queens County Railway, New York City, there is in use a method for removing air compressors from street cars and for again installing them that has greatly simplified what has, in the past, been both hard and tiresome work. Considerable blocking was formerly required to handle these units; but by the new arrangement devised there blocking is no longer necessary.

As the accompanying diagram shows, a small pneumatic elevator, made up of an 8x12-inch brake cylinder, has been fastened securely to one of the side walls of the overhauling pit. The relative position of this elevator to the pit is such that when the cylinder piston has almost reached its maximum of travel a 17x24-inch oak platform, fastened to the piston, will come in contact with the car compressor. The air supply is controlled by a motorman's valve and fed through suitable piping.



Courtesy, Electric Railway Journal.

Cross section of the overhauling pit, showing the arrangement of the pneumatic lift employed to remove and to install compressors in street cars.

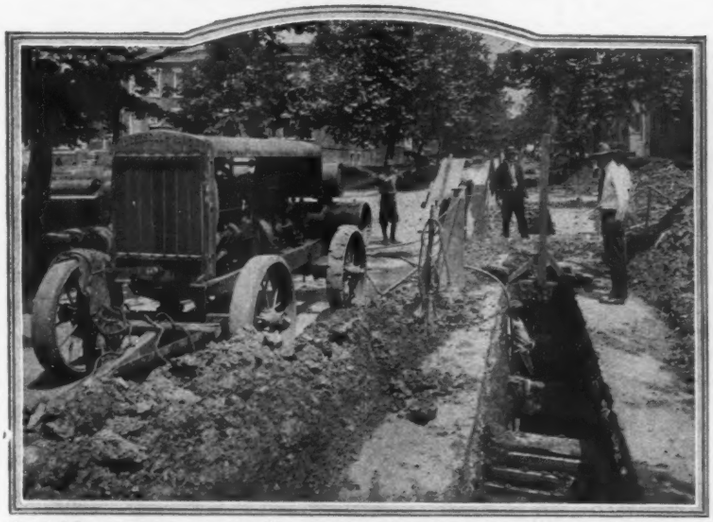
When it is desired to remove a compressor, the car is run over the pit so that the compressor is spotted over the elevator. With this done, air is admitted to the cylinder until a truck, previously wheeled on to the platform, is in contact with the compressor, which is then unbolted. After that the air is released, and it is an easy matter to roll the truck with its load on to the floor level. The operations are reversed when it is desired to put the compressor back in place.

A Munich architect offers as a means of traffic relief something quite new in architecture—nothing less than a spherical house. He has gone so far as to have a structure of this type built. According to his calculations, a building 98 feet high and 82 feet in diameter will require a base but 16½ feet wide, thus making it possible to lay out streets three times as wide as at present. Besides this advantage, the architect points out that his ball-shaped house has access to light and air from all sides and that an unobstructed view may be had from any point of the structure.

High-Pressure Steam Line Welded and Annealed in Trench

By HENRY HARRISON

THERE was completed not long ago, in Philadelphia, by the Philadelphia Electric Company, a pipe-laying job of unusual interest that proves once again what can be achieved when engineers put their heads together to solve problems placed before them. The main in question is an 18-inch high-pressure steam line, with steel walls ½ inch thick, extending south for a distance of three-quarters of a mile along Ninth Street from Willow to Filbert Street, where it connects with an existing steam main. It traverses a very thickly populated section of the city—in fact, one of the principal and busiest thoroughfares.

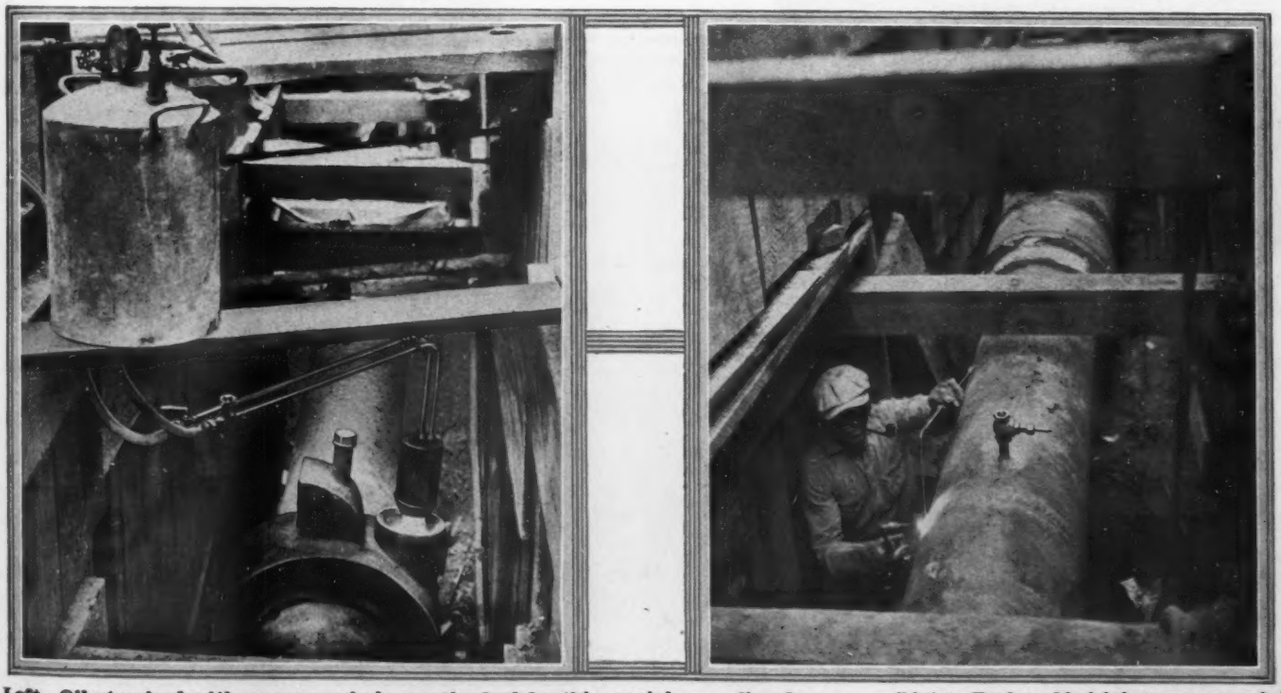


Portable compressors can be used to advantage as a source of air when annealing welded pipe joints by means of heat supplied by an air-oil torch.

Before the contract was let, engineers went over the ground carefully and consulted with several companies in the business. After due consideration, an oxy-acetylene-welded line was decided upon; and the job was awarded to the American District Steam Company, of North Tonawanda, N. Y.—the actual work being performed by the Northeastern Piping & Construction Company, a subsidiary. The outstanding feature of the project lies in what was done to insure the safety of the welded joints.

Considerable difficulty was experienced in excavating the trench for the main which, as previously mentioned, traverses one of Philadelphia's most congested streets. To get beneath existing obstructions in the form of gas mains, electric-cable conduits, sewage systems, etc., it was necessary to remove from 12 to 18 feet of earth. Section after section, the pipe was lowered into place and the joints welded at the bottom of the ditch—the lengths being delivered on the job with chamfered edges. The use of flanged piping was out of the question. The task of welding was anything but an easy one. An accompanying photograph, showing a welder at work 14 feet below ground, gives a good idea of the conditions under which the men had to labor, as well as of the amount of timbering required to prevent the walls from caving in.

And now we come to the precautionary measures taken by the enterprising Philadelphia public-utility company to make sure that the joints were secure. After a weld was finished, the metal on each side of the joint was annealed for a distance of 6 inches. This represented something of a problem, and involved the construction of a special furnace that could be counted upon to do the work required of it without injuring other near-by service lines. This furnace was designed and built by the American District Steam Company; and it took months of experimenting to determine the size of furnace necessary to heat treat a band of metal—approximately 13 inches wide, 60 inches in circumference, and half an inch thick—to a dull cherry red while evenly distributing the heat.



Left—Oil atomized with compressed air was the fuel for this special annealing furnace. Right—Each welded joint was annealed for the purpose of removing stresses set up during the deposition of the welding metal.

In annealing a welded pipe joint, the best results are obtained with a soft, non-oxidizing heat given off by fuel oil. Several types of atomizing oil burners on the market were tried in connection with the furnace—the choice finally going to the Kress atomizer manufactured by H. H. Kress, of Philadelphia.

The furnace, shown in one of our illustrations, consists of a heavy steel jacket or casing lined with heat-resisting fire clay. It is in two parts; and, when fitted in place, equally distributes the heat throughout the entire area and mass of metal being annealed. The oil burner or atomizer is operated with compressed air which, in this particular case, was furnished by a portable Ingersoll-Rand compressor. When correctly suspended, with the flame directed downward, the burner—under service conditions—consumed about 12 cubic feet of free air per minute at 60 pounds pressure. With fuel oil at 8 cents a gallon, the total cost of preheating the metal was less than $2.50 a joint. This included charges for labor—such as getting the hood and the 2-part furnace in position, and operating and maintaining the air compressor. The flame produced by the burner is about 4 inches in diameter and 36 inches in length. It is clear white at the cone—indicating a high percentage of combustion.

After the completion of the annealing process, the furnace was left over the joint long enough to give the metal ample time to cool or to contract so as not to induce undue strains. Next, a sleeve or collar, 12 inches long and 3/8 inch thick, was placed over each seam and firmly welded to the main. Finally, expansion joints were provided at either end of the high-pressure steam line, and its entire surface given a heavy coating of asbestos to protect the steel walls from erosion.

RARE FIND IN ENGLAND OF THREE-EYED LIZARD

THE fossil remains of a plesiosaurus, an extinct member of the lizard family which is estimated by geologists to have lived between 100,000,000 and 200,000,000 years ago, was unearthed recently, according to *Rock Products*, in the Red Triangle Quarries at Harbury, Warwickshire, England.

The find is of uncommon interest and considered a rare one because the head, which is usually missing in discoveries of this sort, was attached to the skeleton. The head is triangular in shape and has a third eye on top of the skull. In man, the vestige of the third eye remains in the form of the pineal gland.

The skeleton is 16 feet long. This is an exceptional length, as most of the fossil remains of this prehistoric animal heretofore discovered have not measured more than 6 feet from head to tail. The specimen was dug out of a bed of lias clay, the oldest and lowest division of the Jurassic system of strata in Europe.

It is proposed to connect Spain with Africa by means of a tunnel under the Strait of Gibraltar. The scheme has recently been submitted to the Spanish Government which, report has it, looks upon the project with favor.

MOTOR HORN OPERATES TRAFFIC SIGNAL

A TRAFFIC signal that is set in motion by the blast of the horn of an approaching automobile—that is, by sound waves—has been devised by Charles Adler of Baltimore, according to *Public Safety*. It has been provided, as the inventor puts it, in answer to the need for something better than the time signal at points in less congested districts where the main artery of travel is intersected by a road carrying a lesser volume of traffic and where, under present conditions, the stream of vehicles is often held up to await the signal "Go" even when the path is clear.

The signal involves the use of the familiar 3-colored sentinel, placed in the center of the crossroads, and of two microphones suitably housed and affixed to posts at opposing street corners. To assure for himself a safe passageway, the motorist on the minor road has only to sound his horn when close to the telephone transmitter. The resulting vibrations are picked up by the particular microphone and communicated to the signal mechanism, causing it to shift electric circuits and to change the lights pointing in the direction of the main thoroughfare from green to amber and then to red. The lights so flashed remain fixed for any predetermined length of time—generally for ten seconds, and are then automatically restored to normal. The system is now being tried out in an outlying district of the City of Baltimore by the local police department.

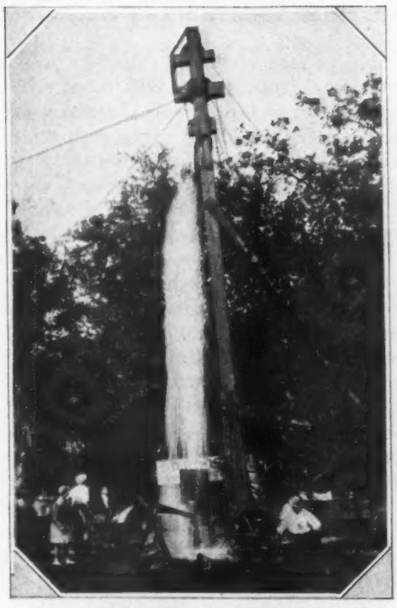
Snapshots of some of the high spots of the recent Quarrying Plant Exhibition held at Blackpool, England, and a few of the interested visitors.

Air Lift Provides Water for Texas Swimming Pool

FORT Worth, Tex., has its periods of pretty warm weather in the summer time, like many other sections of the South and Southwest; and by way of contributing to the comfort and the enjoyment of its citizens, Fort Worth has provided a municipal swimming pool, of ample proportions, which has proved increasingly popular ever since it was first made available about two years ago.

Swimming pools in the neighborhood of Fort Worth are not novelties—there are a number of them, but nearly all depend upon surface water to fill them. The surface water is decidedly hard and not pleasing to the taste when the swimmer, by chance, happens to get a mouthful of it. The Fort Worth pool is different in this respect because its water supply is obtained from an Artesian well that furnishes exceptionally soft water, so it seems. This difference has appealed strongly to the patrons of the municipal swimming pool. The pool is large enough to hold, when filled, 400,000 gallons; and the practice has been to drain it completely and to replenish the water every three weeks. Notwithstanding this procedure, fresh water to the volume of 100,000 gallons is pumped into the pool daily over a period of from six to seven hours.

The capacity of the deep well, measured by the foregoing flow, is 270 gallons per minute; and the water is raised to the surface by means of an air lift installed for that purpose. As originally drilled the well was 16 inches in diameter; but it is now cased to 10 inches and fitted with 240 feet of 4½-inch flow line, 240 feet of 5-inch flow line, and 490 feet of 1½-inch air line placed outside the flow line. Air for the operation of the well is furnished by a



The air lift when first in action and before it was fitted with an umbrella to direct the discharge.

12x10-inch Class ER-1 compressor—that is, a motor-driven unit. The installation has proved notably economical compared with the cost to operate the other pools around Fort Worth. Our illustrations give an excellent idea of the volume of water thus obtainable from the Artesian well. While people do not make a practice of frequenting swimming pools to quench their thirst, still enough of us are familiar with the feeling of hard water to realize how much pleasanter it is to bathe in really soft water. The Fort Worth pool attracts daily several hundred persons; and at times it has been patronized by nearly a thousand.

NEW FORM OF DRIVE FOR BARGES

HYDRAULIC turbines are being tried out in France for the propulsion of a special type of canal barge built by the Société des Propulseurs Hydrauliques, according to the American Trade Commissioner at Paris. The vessel is equipped with two heavy-duty, internal-combustion motors, one in the bow and one in the stern. Each motor drives two vertical turbines located just below the water line and close to the side of the hull. The two after turbines are inclosed in articulated cylindrical casings.

The water is drawn in through a fixed central opening, at the bottom of each turbine, and forced out through a lateral opening in its movable casing—the motion of the vessel being obtained in reaction to the horizontal jet of water caused by the rotation of the vertical turbines. It is claimed by the manufacturer that this form of drive for canal barges has advantages, under conditions, over that of the usual screw propeller.

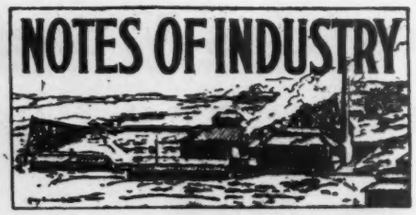
The railway system of Peru is to be extended by 575 miles of new lines. Work on some of these is now in progress. Just what railroad building means in that mountainous country can be appreciated when it is known that a stretch of road but 11 miles in length will require the driving of 50 tunnels.

Left—Measuring weir used to ascertain the flow of the well. Right—Sampling the water for analysis.

NEW MACHINE FOR TESTING INSULATED CABLE

A DRY-TESTING machine for insulated electric conductors has been installed at the Oberspree Cable Works of the Allgemeine Elektrizitaetsgesellschaft, Berlin, Germany, that is a great improvement over the method previously employed there for determining the strength of the insulating material. By the old standards, the test voltage could not be applied until after the conductor had been immersed in water for 24 hours. Besides the length of time involved, it was possible in this way to locate only the weakest point in the cable; and when the lead at this point broke down under the test voltage, the water that penetrated could not be removed even by careful drying in a vacuum.

To overcome these drawbacks, and to keep pace with the present-day mass production of insulated cables, the dry-testing machine was developed. We are told that it not only does the work much quicker but also much better than the method heretofore specified by the Association of German Electrical Engineers. According to a description of it in *Engineering Progress*, the apparatus tests insulated cables up to a maximum pressure of 16,000 volts. The conductor is run from a drum through a metal hopper filled with steel balls and fitted beneath with metal fingers that rest against the underside of the cable as it travels along. The hopper is connected to one of the poles of a transformer while the other pole is in contact with the frame of the machine. Right above the hopper is placed a paint spray which plainly marks with a spot of paint each point in the line where the insulation has broken down. A strip of paper passes through the machine at the same rate of speed as the cable and records these defects, which can be easily detected and remedied later on.



The presence of potash salts has been discovered in a thick bed of rock bored recently in search of oil and gas in Gautreau, Westmoreland County, N. B. The rock stratum, 485 feet in thickness, was encountered at the 1,295-foot level; and each of the samples sent to the Dominion Department of Mines for analysis contained potassium.

A survey is being made by airplane of 11,000 square miles of territory to the west and south of Bagdad along the River Tigris. The maps are to serve in laying out an extensive irrigating system.

The newest dry dock in the Port of New York will be 715 feet long in the clear, have a floor width of 93 feet, and be 113 feet wide at the top. From top to bottom the dock will be 40 feet deep. When completed, about a year and a half hence, the dock will cost $2,000,000.

The twin ports of Port Arthur and Fort William, on the Great Lakes, are said to be the world's greatest granary. At the present time, the elevators located there have a storage capacity of 72,540,000 bushels of grain, as compared with 53,000,000 bushels at Chicago and 58,000,000 at Minneapolis. By 1930, when one of the largest terminal-building projects in the history of the Great Lakes will probably have been completed, the twin ports will be able to take care of about 100,000,000 bushels.

A weekly air service has been established between Port Nolloth, Namaqualand, and Capetown, for the purpose of transporting diamonds from the Namaqualand fields. Three aerodromes have been erected at Steenkopf, Alexander Bay, and Port Nolloth, respectively; and, by consent of the Department of Defence, two members of the South African Air Force are in charge of the service.

An unusual application of chromium, says *The Engineer*, is the plating of files that are to be used in cutting soft metals. Not only is the life of the tool thus greatly increased but it has also been found through use that the metal cuttings do not, as in untreated files, clog up the teeth.

What is claimed to be the largest floating factory in the world was completed not long ago for use in connection with the Newfoundland fisheries. The plant has a displacement of 1,540 tons. Mechanical devices have been installed for beheading and gutting the fish—the offal being made up into fish meal.

A bill has recently been passed by the Legislature of New Brunswick giving consent to the project, as conceived by Dexter P. Cooper, for the development of tidal power in Passamaquoddy Bay.

Between the years 1913 and 1927 the world production of petroleum increased about 243 per cent.

What is said to be the largest plant in the world for the production of anhydrous alcohol was put in operation not long ago by the German Alcohol Monopoly at Berlin-Reinickendorf. The plant was constructed according to the Ricard-Allenet patents, and is designed to produce 8,500 gallons of 100 per cent alcohol daily. Dehydration and purification are effected in one step. The product is to be utilized in the manufacture of "Monopoline", a liquid motor fuel consisting of 90 per cent gasoline and 10 per cent pure alcohol.

A freeport is being established by the Government of Venezuela at Turiamo.

Tests made in the indoor swimming pool of the Detroit Athletic Club have disclosed that the water can be effectively sterilized by exposure to the germ-killing rays of ultra-violet electric lamps. This process does not change the color nor the taste of the water in any way.

Although decidedly active, the gypsum industry in the United States did not produce as large a volume of the mineral in 1927 as it did in 1926. The quantity of gypsum mined in this country in 1927 was 5,346,888 tons—5 per cent less than the output of 1926.

According to the American Tree Association of Washington, D. C., our railroads use 110,000,000 crossties every year. It takes from 30 to 60 years, so it seems, for trees to grow big enough to produce lumber for that purpose.

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Portable compressors and I-R paving breakers helping in relaying the block pavement at the Hyde Park end of London's famous Piccadilly.

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EDITORIALS

OUR NATIONAL PARKS DRAW MILLIONS TO THEM

OUR nineteen national parks and thirty-two national monuments have attracted to them during the past vacation season, so it is estimated, a total of 3,000,000 persons on recreation bent. This steadily increasing tide of appreciative nature lovers is ample warrant for all that the Government has spent in making these areas available to tourists and in amplifying the accommodations or the camping grounds at the disposal of the public.

The Federal authorities will expend a matter of $4,600,000 in maintenance and improvement work in connection with the national parks and monuments during the current year; and the Congress has authorized the disbursement of an additional $4,000,000 for roadbuilding. Every now and then we have mentioned a number of these roadbuilding tasks pushed to completion in scenically beautiful but remote regions. All of them have involved work in difficult and, at times, hazardous situations and have necessitated the removal of large quantities of interfering rock. The undertakings would have proved prohibitively costly but for the mobility of the portable compressor and the time-saving and labor-lightening help of the air-driven rock drill. The money allotted for roadbuilding in these governmental recreation centers would, therefore, have had to be in much larger sums if engineering cunning had not placed mechanical aids of this description at the disposal of the roadbuilder.

All told, our national-park system embraces a total area of 11,817 square miles. During 1927, entrance fees were collected at the parks amounting to substantially $703,850. It is highly likely that three other parks will be added to the system. One will be in the Great Smoky Mountains, in Tennessee and North Carolina; a second will be in Virginia, and known as Shenandoah Park; and the third will be Bryce Canyon National Monument, which will be officially known as Utah National Park. In these projected parks, as well as in the existing ones, new highways and new trails will be constructed for the convenience of the public and for the further enjoyment of the scenic beauties or wonders that Nature has provided there in abundance.

AMERICA WORLD'S GREATEST FUR MARKET

LAST year the United States imported furs valued in excess of $123,000,000; and we draw furs of all kinds from every part of the world. Why have we assumed this position of preëminence? It is not merely because fashion has decreed that it is proper to wear furs the year through—our unparalleled purchase of furs is probably attributable in large measure to the ever-widening use of the motor car that takes people out of doors in all seasons and in all kinds of weather, incidentally necessitating protecting garments and recourse to the warmth to be had from even light-weight pelts.

Our demand for furs has encouraged fur-raising and fur-taking, both in this country and in Canada, to an extent not generally realized. According to an authoritative survey made recently, there are approximately 2,500 farmers in the United States and Alaska engaged in rearing one or more species of fur-bearing animals—most of them operating silver- or blue-fox farms; and the total investment in the business ranges between $15,000,000 and $18,000,000. There are more than 2,700 fur farms in the Dominion of Canada, with a total investment in land, buildings, and animals of about $15,000,000; and last year approximately 63 per cent of Canada's fur exports entered the United States.

Needless to say, silver- or blue-fox furs are not bought by the populace at large; but the general demand for furs has stimulated the gathering of cheaper pelts—many of which are transformed by dyeing and skillful handling to simulate more expensive furs. As a consequence, pelts of animals heretofore neglected are now being taken in increasing quantities. Muskrat farming is developing upon a large scale; and the pelts of certain rabbits, previously looked upon as pests, are being marketed in great numbers. In the Windermere Valley of British Columbia, a company of fur farmers recently acquired rights to 200 square miles of marshland for the purpose of carrying on muskrat and beaver ranching.

In 1927, Canada's exports of furs rose to $22,520,163 from $19,489,589 during the preceding year; and United States imports were largely responsible for that increase. Perhaps nothing in the fur business during the past year was more significant than the augmented number of undressed seal skins sold—the figure mounting from $54,589 in 1926 to $112,352 in 1927. This is traceable to the treaty entered into by the United States, Canada, Japan, and Russia. In 1911, the diminishing herd was said to total 196,000 seals, while today the Pribilof Islands are the breeding grounds of more than 900,000 seals. Protective measures have thus added tremendously to the economic value of this aquatic source of wealth.

NORTHWEST PASSAGE MAY BE USED FOR TRADE

WHEN the Hudson's Bay Company was founded more than two and a half centuries ago, its organizers hoped that it would be possible to use the waters of the Arctic region north of America as a means of communication between the Atlantic and the Pacific. It was not until 1845 that Sir JOHN FRANKLIN sailed from England with two ships equipped by the Admiralty for the purpose of discovering a northwestern passage that might be utilized by trading vessels. It is a matter of history that Sir JOHN and his companions perished in the effort. Between 1850-1854, Sir ROBERT M'CLURE discovered and navigated the so-called Northwest Passage, but the route was not then believed likely to lend itself to commercial use.

Between 1903-1906, Capt. ROALD AMUNDSEN, in the small schooner *Gjoa*, traversed that more or less sheltered or land-locked route, and in 1918-1920 he again traced those waters with the schooner *Maud*. The recent tragic loss of Captain AMUNDSEN gives added interest to the plans now being developed by the Hudson's Bay Company in an effort to utilize the Northwest Passage for its trading service. According to a report made a few weeks ago by CHARLES V. SALE, governor of that famous enterprise, it is disclosed that the fur-trade department of the Hudson's Bay Company has been engaged in exploring the commercial possibilities of the Northwest Passage. A small vessel has been equipped to make surveys as long as open water is available, and this will be followed by a party working during the winter and using caterpillar tractors to transport supplies over the snow from Wager Inlet to Cockburn Bay, where a warehouse will be built.

Governor SALE writes: "If in the end our plans prove successful—and who can tell?—we hope to supply a large portion of the western Arctic by an all-Canadian route from our posts on the shore of Hudson Bay. This should lead to economies, because we shall save the long voyage from Vancouver around the dangerous shores of Alaska." It is probable that aviation may play a part in this projected service.

While the Northwest Passage may not become, as originally hoped, a shorter route between England and the Far East for the transportation of silks, spices, and the special commodities of the Orient, nevertheless the utilization of the passage in promoting and safeguarding trade will represent the overcoming of many physical difficulties through agencies that were not available in 1854, when M'CLURE considered the waterway unsuited to the then existing limitations of trading craft. Thus we move onward in this world!

BONIFACE RECEIVES HIS COLLEGE DEGREE

"PUDDIN'HEAD Wilson", in his calendar of wise sayings, noted that the cauliflower was a cabbage with a college education. Many of us have wondered whether hotel managers just grew up as such or were the product of intensive education—often at the unpleasant expense of the transient public. A recent news item from Ithaca, N. Y., reveals that the up-to-date members of a hotel staff—if they are really good—hold their positions because of college training now available to aspirants in this field of public service.

Cornell University, for the past six years, has had a regular 4-year degree course in hotel administration; and this part of the curriculum has latterly embraced short summer courses in the same subject, the first of the kind to be given in an eastern University. The current year's summer course was attended by 29 hotelmen from 12 states, and the students included hotel proprietors, managers, clerks, chefs, auditors, and even head waiters. We are informed that the summer session gave the hotelmen both classroom and laboratory work from 8 in the morning until 5 o'clock in the afternoon of every weekday; and they had to study at night, besides, to keep up with each day's assignments. Instruction was given in hotel accounting and in the preparation of food. After completing their studies, the students returned to their respective hotels to put into practice the ideas gained at Cornell. It is announced that additional courses, covering hotel engineering and psychology, are to form part of the work cut out for the school next summer.

The modern hotel is a self-contained community with a decidedly complex organization; and to maintain it at the standard demanded by an exacting public calls for varied and intimate understanding of the proper administration or upkeep of the numerous different departments. We can easily grasp why a college degree would be desirable and even necessary. The inclusion of psychology may sound a bit too academic to the man that views the hotel merely as a place where he can get satisfactory bed and board; but when thought is given to the diversified problems confronting the room clerk and the cashier, a little insight into the ways of working of the human mind might save a lot of trouble and a fair measure of regret.

Turning out candy enough in a twelvemonth to justify the use of its own refrigerator cars is the boast of the Curtiss Candy Company of Chicago, Ill. That company will soon have in service 200 of these special cars, and is planning to acquire a fleet of 1,000 to distribute its commodities throughout the United States. It might be well to mention that 18,000 cars are required each year to move the necessary raw materials to the plant and to ship the finished product. According to railroad officials, this is the first time to their knowledge that a concern of this kind has ever had such cars built for its exclusive use.

BUSINESS THE CIVILIZER, by Earnest Elmo Calkins. An illustrated work of 309 pages, published by Little, Brown & Company, Boston, Mass. Price $3.00.

MR. Calkins has won for himself a position of eminence in the business of advertising; and the present book reflects his general knowledge as well as his ripe experience in his chosen calling. It is his theory that business is "the great civilizer, the trustee of reason, enlightenment, comfort, and material progress." With this conception, it is easy to understand how, with his alert mind and facile pen, he has been able to produce a book that is full of worth-while material from start to finish. We have heartily enjoyed reading it.

HEALTH AND WEALTH, by Louis I. Dublin, Ph.D., Statistician Metropolitan Life Insurance Company. A book of 361 pages, published by Harper & Brothers, New York City. Price, $3.00.

THIS book, really a survey of the economics of world health, is made up of fifteen essays written by Doctor Dublin and based upon various addresses made by him during the last three or four years. As a statistician on the staff of one of the largest of America's insurance companies, Doctor Dublin has had ample opportunity to evaluate health in terms of dollars and cents; and the reading of his book will bring this fact home in a convincing and, perhaps, in an astonishing manner.

The sick person is seldom a gainful one, especially when suffering or incapacitated by his physical condition; and as the sick list of the nation is a large one the monetary loss is correspondingly great even though we take no account of death or abridged years of usefulness. The chapters of this admirable book cover such topics as the cost of raising a child; the value of a man; and health, peace, and prosperity, not to mention the question, *Has Prohibition Improved the Public Health*? Finally, he writes upon the possibility of extending human life, and he adduces some extremely significant figures and facts.

STORAGE BATTERIES, by Morton Arendt, E. E., Assistant Professor of Electrical Engineering, Columbia University, New York City. An illustrated work of 285 pages, published by D. Van Nostrand Company, Inc., New York City. Price, $4.50.

IN this book the needs of the practical man have been considered throughout, and the theory of storage batteries has been dealt with only in a general way. However, another theory has been incorporated to make clear the fundamentals of storage-battery chemistry and cell characteristics, particular attention being given to the diffusion of electrolytes and to plate construction. We believe this book will prove a helpful guide to many having to do with the manufacture and the assembling of storage batteries and with their upkeep and care.

MECHANICS FOR ENGINEERS, by Julian C. Smallwood, M.E., and Frank W. Kouwenhoven, M.E., both of the staff of Johns Hopkins University. An illustrated work of 185 pages, published by D. Van Nostrand Co., Inc., New York City. Price, $2.50.

THIS book is designed to supplement class work and to give the more or less immature student of applied mechanics a somewhat leisurely presentation of the subject for independent consideration. The authors do not claim that they have evolved anything new except in the arrangement and the selection of the material. The aim has been to give the student small doses, so to speak, associated with a sufficient number of informative problems to stimulate intellectual digestion. The easiest problems come first, and the different subjects are developed thereafter in accordance with their relative difficulty of comprehension.

PRINCIPLES OF VALUATION, by John Alden Grimes and William Horace Craigue. A work of 274 pages, published by Prentice-Hall, Inc., New York City. Price, $10.00.

PERHAPS the purpose of this volume can best be explained in the words of the authors: "The objective of this book is the development and comparison of the several mathematical principles which are adapted to the valuation of future income, and a discussion of these principles with respect to their applicability or inapplicability to commercial usage. The threefold treatment has been chosen: the statement of premises, the conversion of the premises into algebraic formulas, and the arithmetical illustrations of the use of such formulas. The only individual factors of valuation which will be discussed are those common to all types of valuation, such as the future rate of interest and the treatment of the future capital expenditures necessary to the realization of the anticipated income." It is claimed for the book that the subject is so treated that it may be clearly understood by the average person of limited mathematical training.

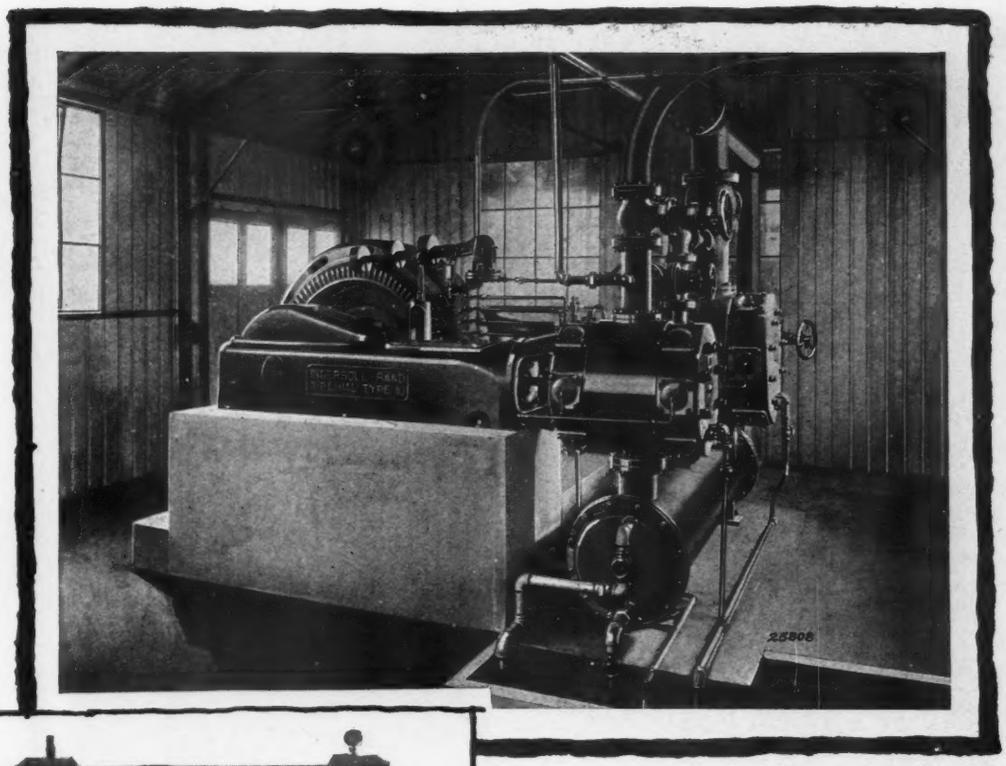
Common Troubles Encountered in the Application and Use of Leather Packings is the title of a folder issued by E. F. Houghton & Company, Philadelphia, Pa.

Cement Gun Shots is the title of an illustrated booklet distributed gratis by the Gunite Concrete & Construction Company, Kansas City, Mo. It shows by pictures what can be done with gunite.

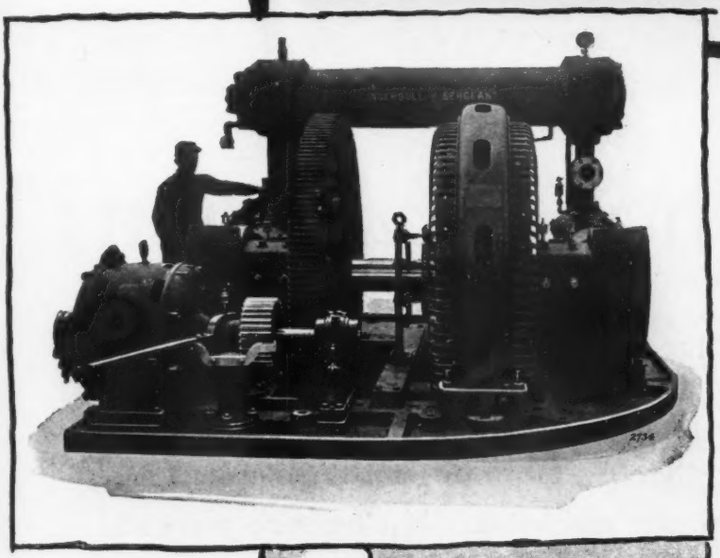
The Carbic Light is the title of a catalogue recently issued by the Oxweld Acetylene Company of New York, Chicago, and San Francisco. It describes how the carbic light can be utilized to illuminate a wide range of jobs.

Functions of the Sales Manager is the title of Volume No. 11, on business organization, issued by the Metropolitan Life Insurance Company, New York City.

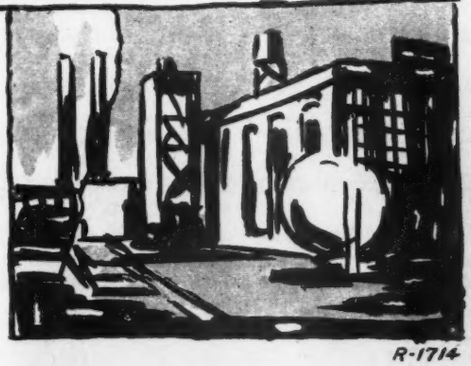
The value of manufactured goods produced each year in Canada has increased from less than $500,000,000 in 1900 to $3,500,000,000 at the present time.



An XRE-2 gas compressor with synchronous motor drive and 5-step clearance control.



The first compressor driven by direct-connected synchronous motor. Built by Ingersoll-Rand in 1906. The small induction motor at the left was used to start the compressor, and bring it up to speed.



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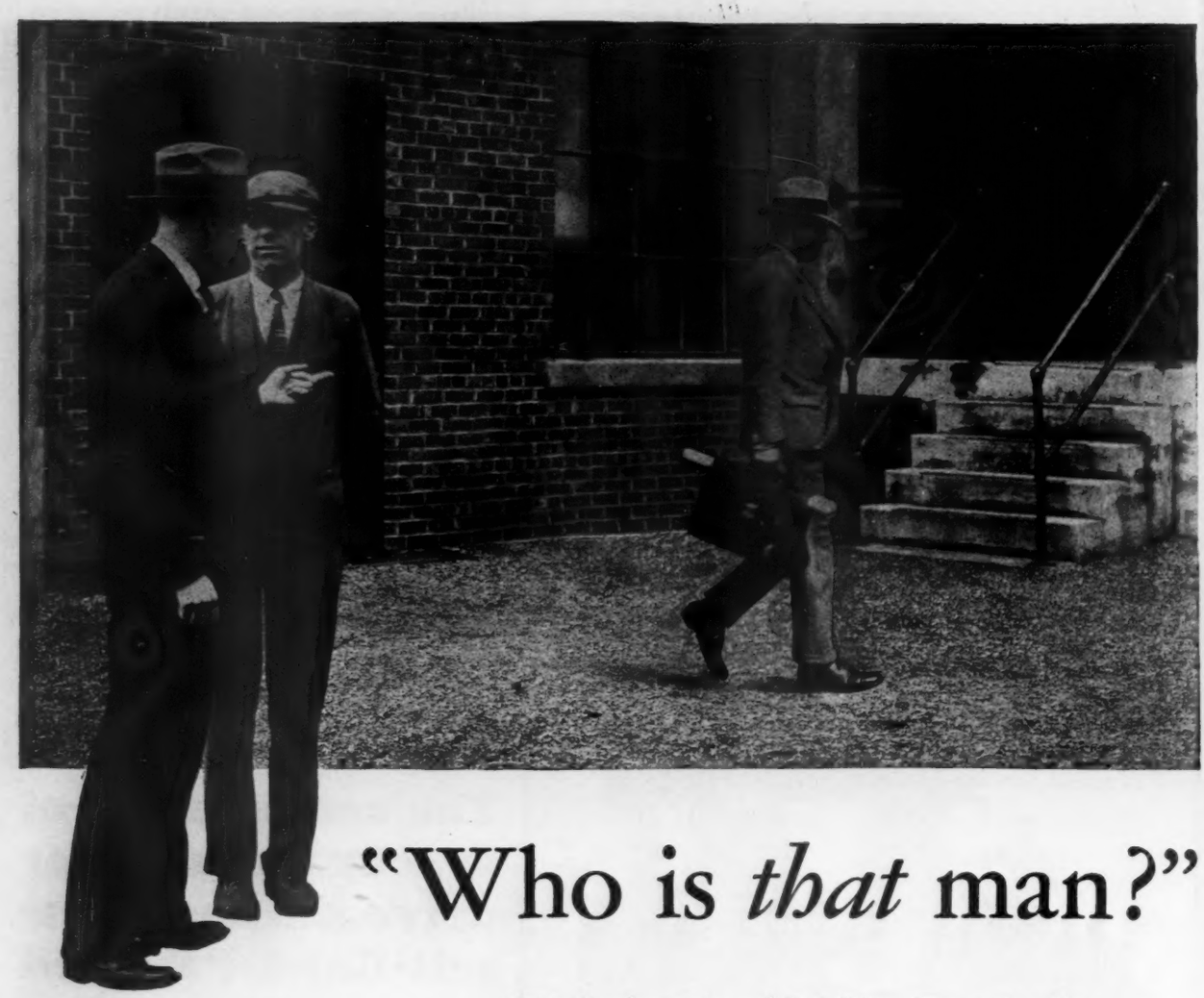

"Who is *that* man?"

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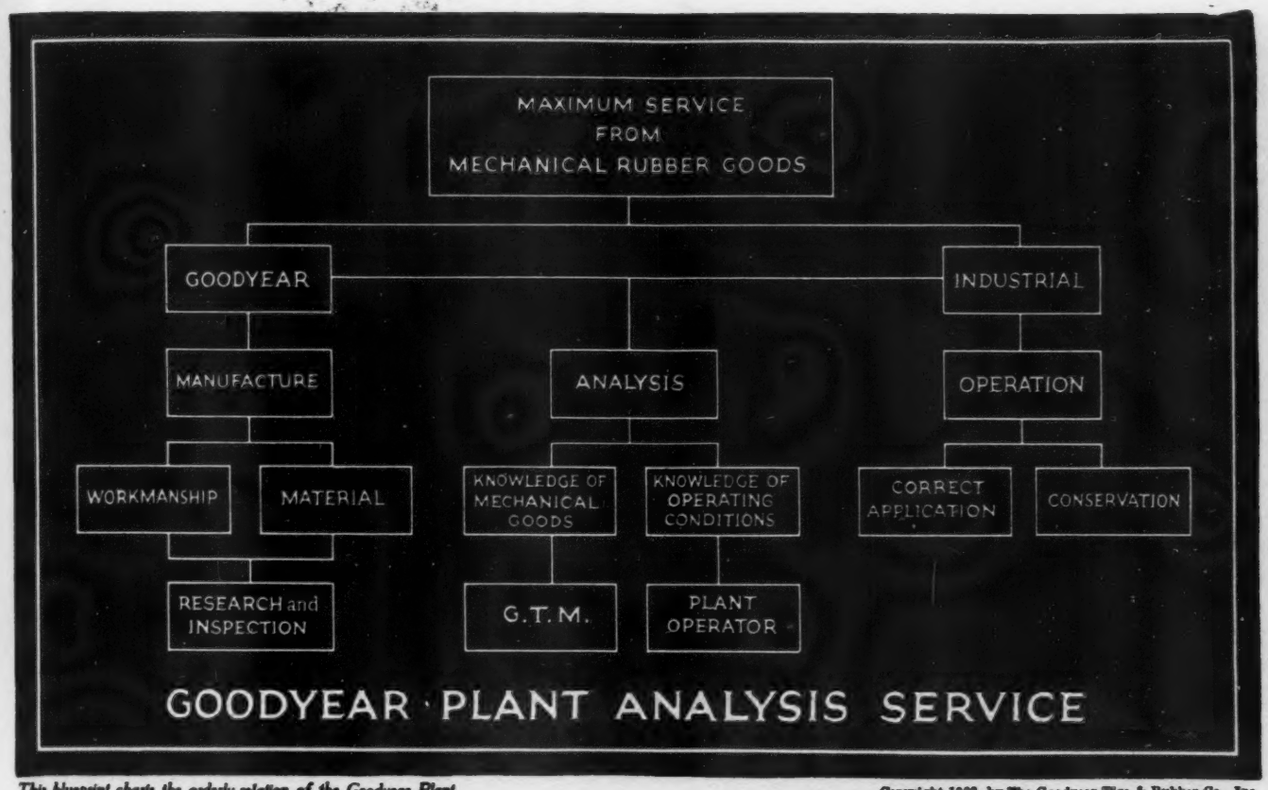

This blueprint charts the orderly relation of the Goodyear Plant Analysis Plan for maximum service from mechanical rubber goods

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The Plant Analysis Plan—and the G. T. M.

This chart is important to every man who has to deal with belting, hose or packing problems. It shows the principal factors in the Goodyear Plant Analysis Plan, and makes clear the part that is played in more efficient, economical plant equipment by the G. T. M.—Goodyear Technical Man.

You know the idea behind the Goodyear Analysis Service. It is simply this, that you are bound to get more work and better work, done more efficiently and more economically, from the *right* mechanical rubber goods, specified to the job. How the *right* product is found by analysis is shown on this blueprint chart.

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His entire purpose is to fit what he knows about belting, hose or packing to the demonstrated conditions of service in your plant. If he can find out what you can use to best advantage, he will recommend it to you. Then, on your order, Goodyear will build your equipment according to those approved specifications. And after it is installed, the G. T. M. will follow it up with a service that will see that you get out of your equipment all the value built into it by this scientific analysis and careful manufacture.

Doesn't it stand to reason that you are likely to get the utmost in trouble-free, long-wearing service out of that kind of equipment? The proof of the Goodyear Analysis Plan is in the records—many of them published in these pages during the past ten years—of better, more productive and more economical work done by G. T. M. specified goods in hundreds of plants, in every line of industry.

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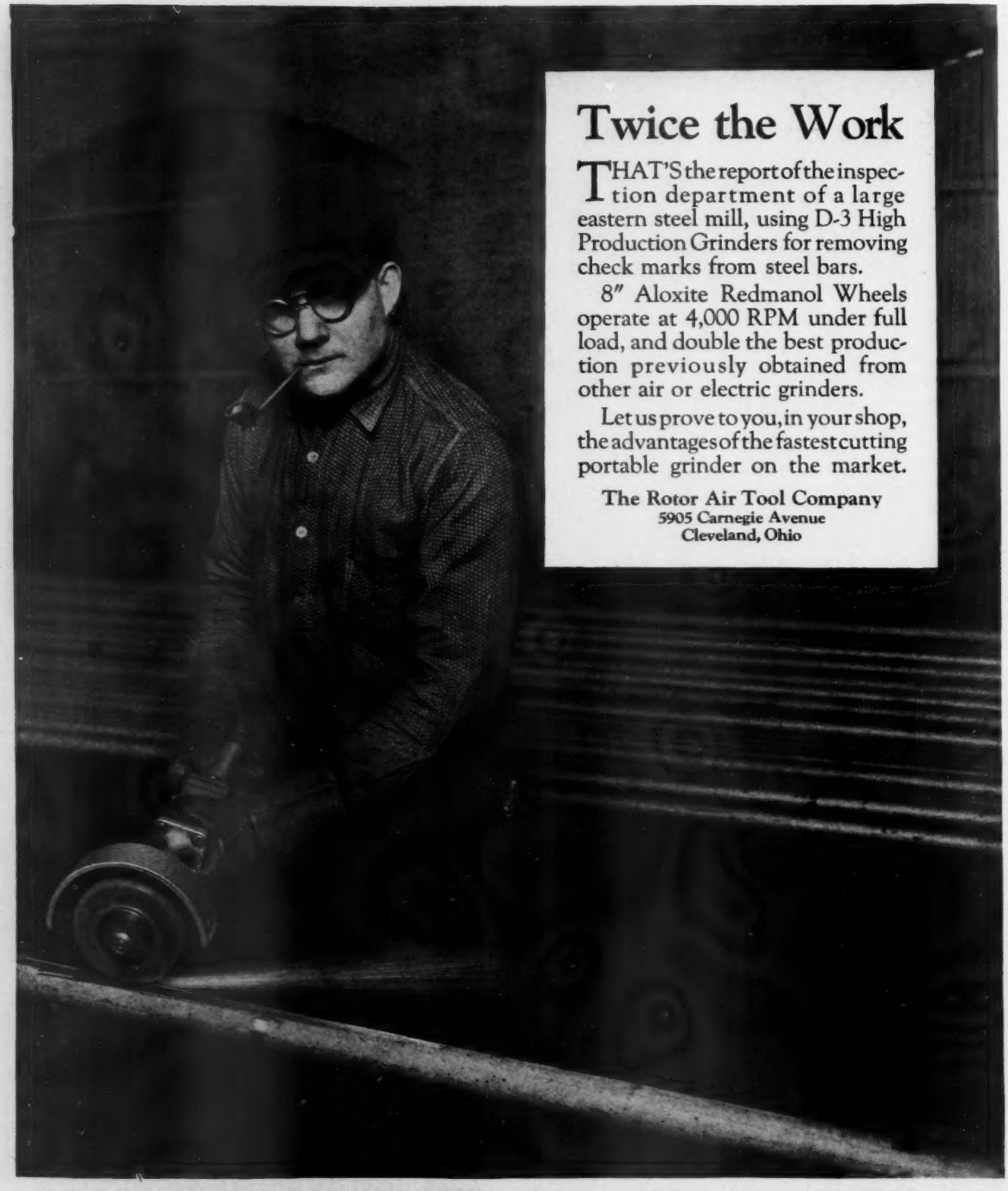

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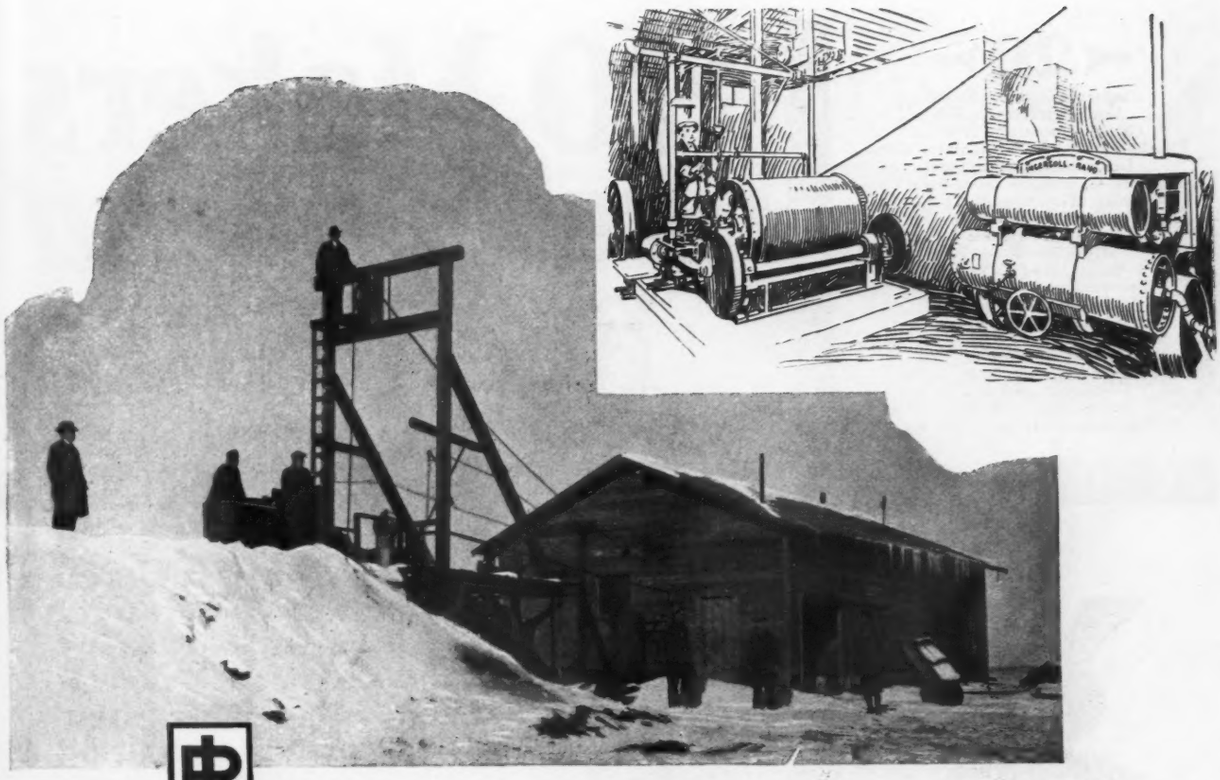

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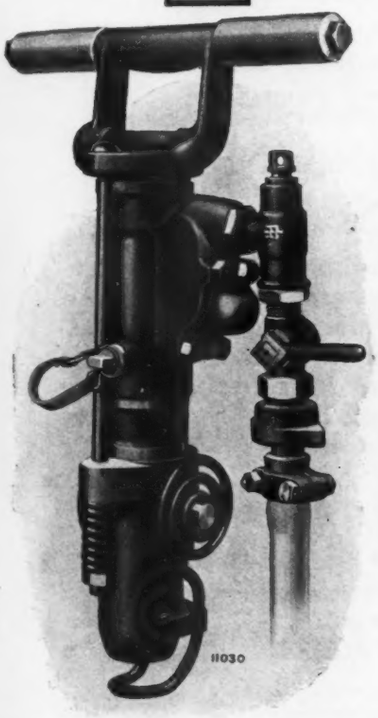

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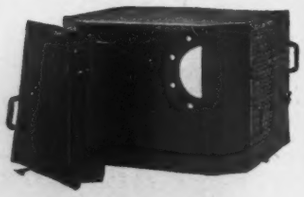

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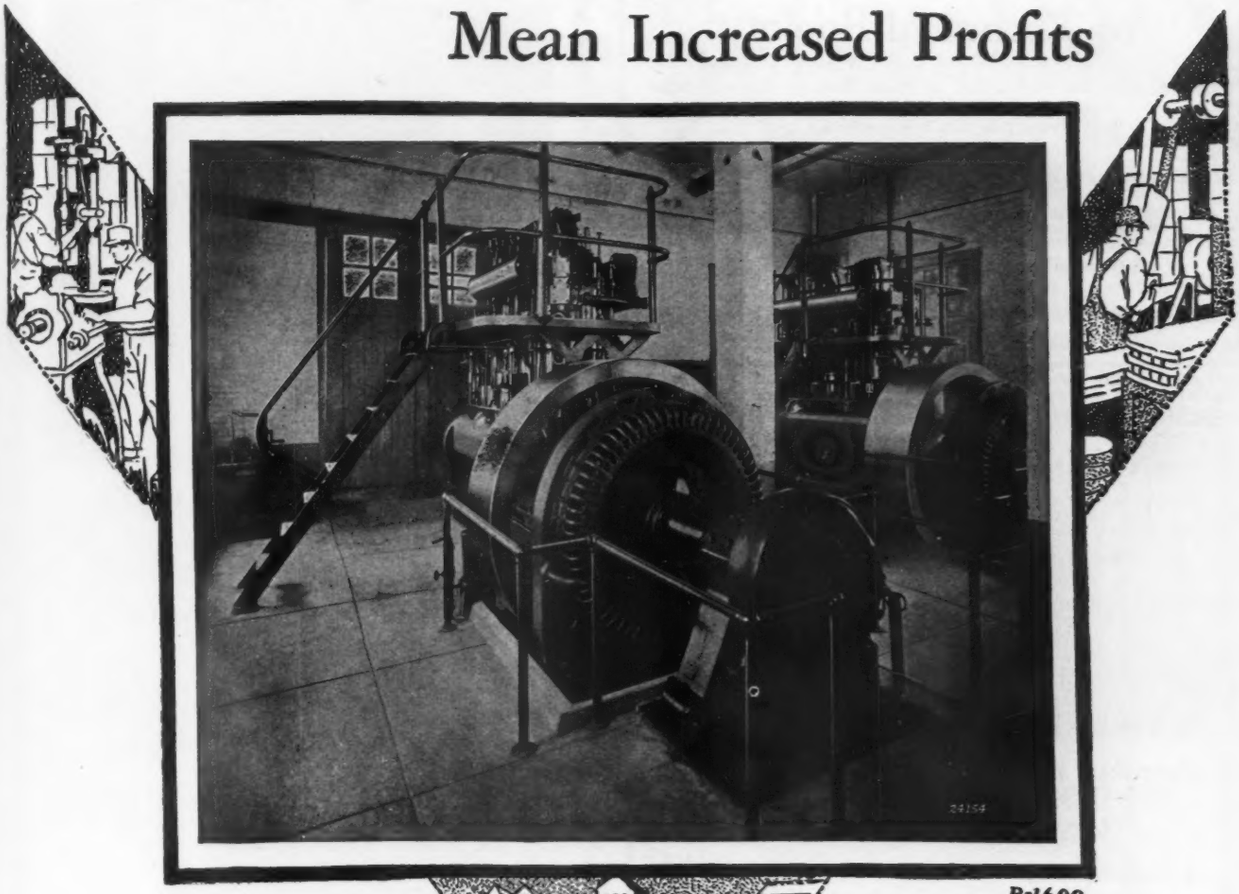

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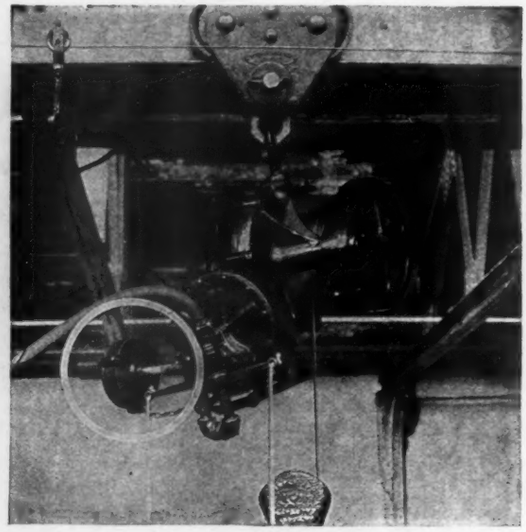

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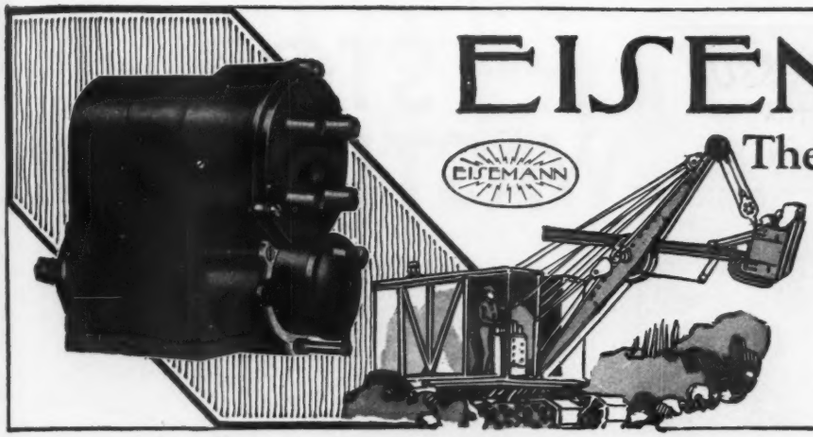

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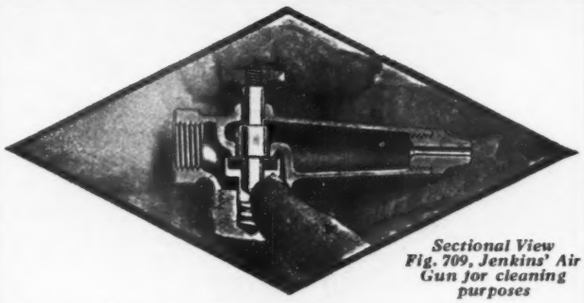

Sectional View Fig. 709, Jenkins' Air Gun for cleaning purposes

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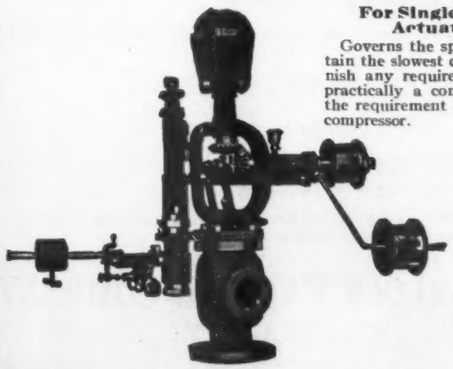

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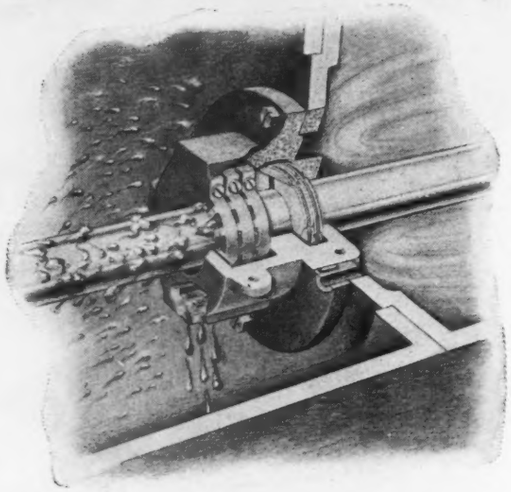

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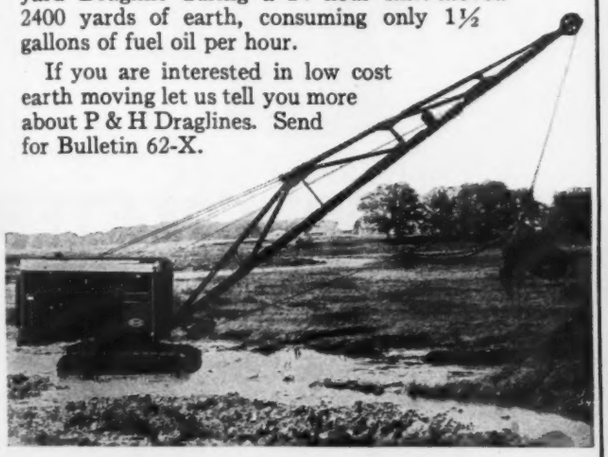

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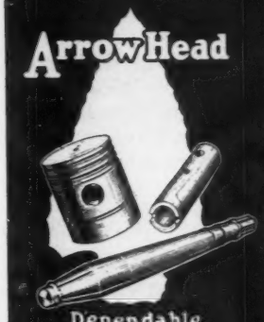

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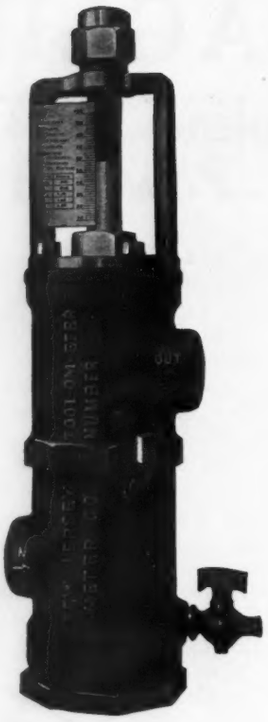

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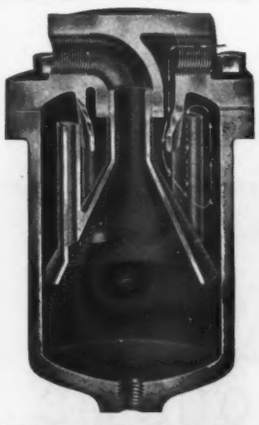

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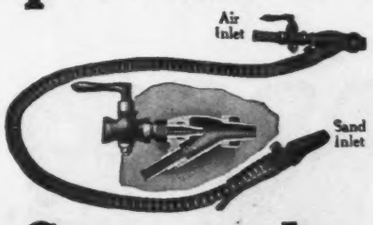

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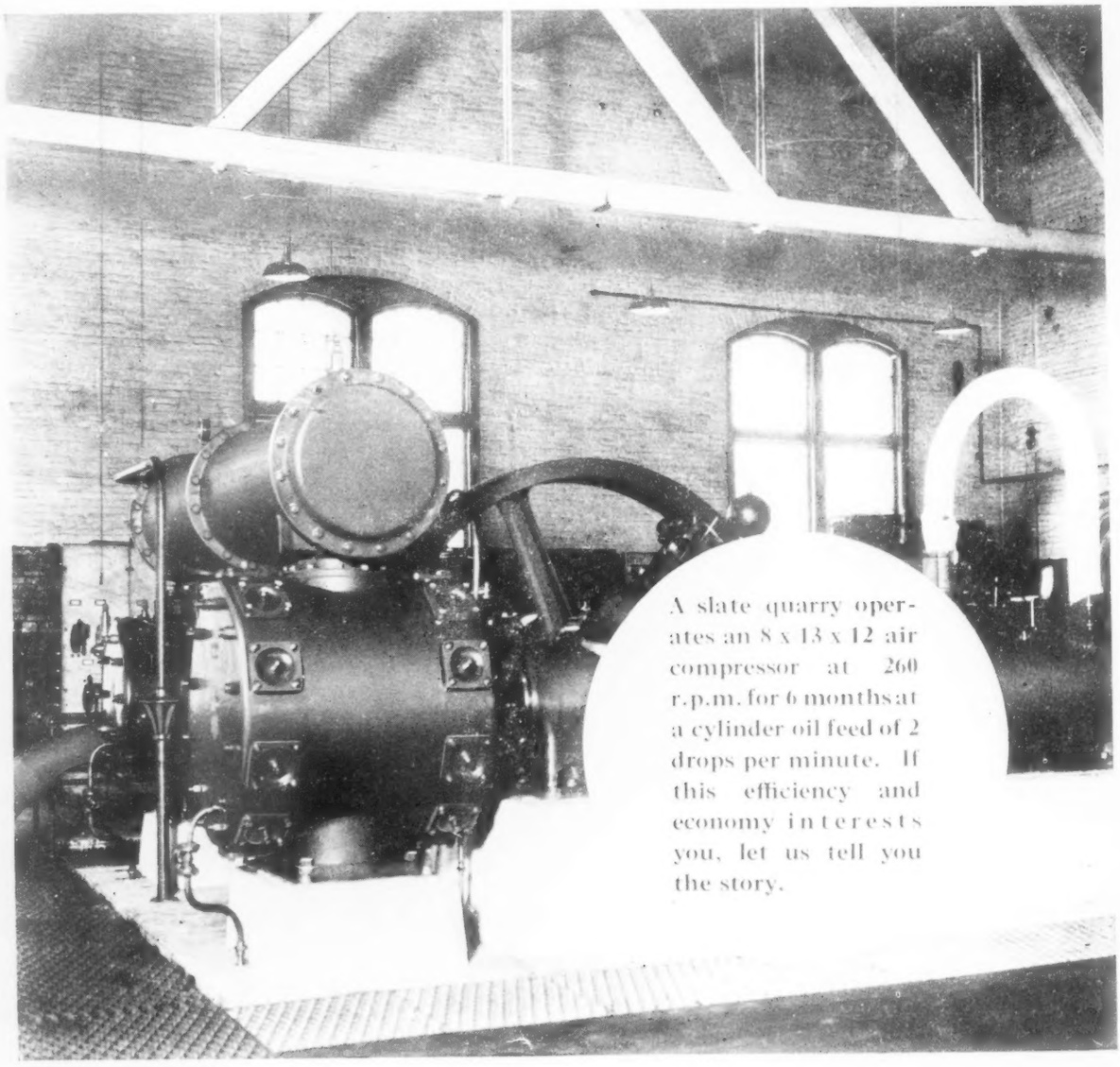

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